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NATIONAL DAM INSPECTION PROGRAM. LAUREL HILL LAKE DAM (NDI I.D.--ETC(U)
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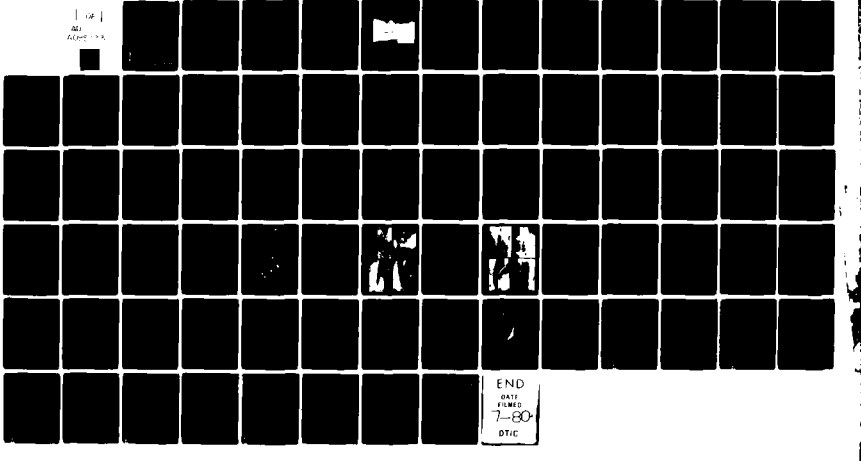

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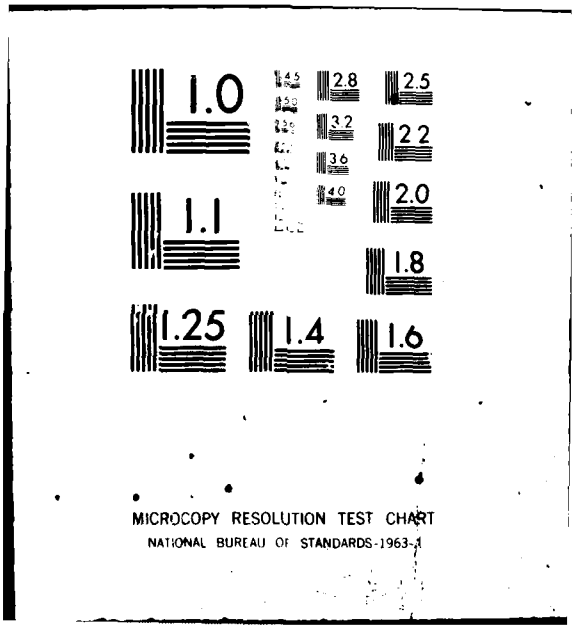
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OHIO RIVER BASIN
LAUREL HILL CREEK
SOMERSET COUNTY

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LEVEL II

PENNSYLVANIA

NDI ID. NO. PA 267
Penn. DER NO. 56-66

LAUREL HILL LAKE DAM

COMMONWEALTH OF PENNSYLVANIA
BUREAU OF STATE PARKS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM. Laurel Hill Lake Dam (Laurel Hill Creek) I.D. number PA-267, Penn. DER Number 56-66

This River Basin, Laurel Hill Creek, Somerset County, Pennsylvania Phase 1 Inspection Report

(10) Janice D. Hanley
Timothy E. Debes

PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase 1 investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase 1 investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigation and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase 1 investigation; however, the inspection is intended to identify any need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase 1 inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM:	Laurel Hill Lake Dam
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Somerset
STREAM:	Laurel Hill Creek, a tributary of the Casselman River
DATES OF INSPECTIONS:	November 20, 1980, and March 4, 1980
COORDINATES:	Lat. 39° 59.4', Long. 79° 14.5'

ASSESSMENT

Laurel Hill Lake Dam is classified as an "intermediate" size, "high" hazard dam in accordance with U. S. Army Corps of Engineers dam safety criteria.

Based on the evaluation of available design information and visual observations of conditions as they existed on the dates of the field reconnaissances, the general condition of Laurel Hill Lake Dam is considered to be good. However, the cause and origin of a seepage zone located downstream of the dam embankment could not be conclusively established by visual observation and review of the construction drawings. Therefore, it is recommended that periodic monitoring of the seep be made by the dam owner. The presence of eroded footpaths, animal burrows, cracking and spalling on concrete surfaces, and shallow depression located on the dam crest, are considered minor deficiencies in need of maintenance.

Guideline criteria recommend a PMF spillway design flood for "intermediate" size, "high" hazard dams. Spillway discharge capacity was found to be seriously inadequate based on the following data:

(1) Maximum non-overtopping spillway discharge capacity is 34 percent PMF,

(2) Failure of the dam resulting from 37 percent PMF overtopping significantly increases the downstream loss of life and damage potential compared to that which would exist prior to dam failure.

Laurel Hill Lake Dam is categorized as "unsafe, non-emergency" in accordance with recommended criteria.

RECOMMENDATIONS

The following recommendations should be implemented as soon as possible:

1. Implement additional studies by a professional engineer experienced in the design of dams to more accurately ascertain spillway channel adequacy and the extent of improvements required to provide sufficient discharge capacity or erosion/breaching protection for the dam.

RECOMMENDATIONS (cont.)

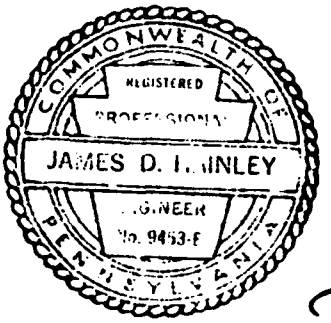
Improvements found necessary by the recommended study should be implemented immediately.

2. Monitor seepage and adjoining wet zone located at the downstream embankment toe. If increased flow quantity or evidence of erosion is observed, the Department of Environmental Resources, Dam Safety Division should be notified immediately, and necessary corrective repairs made.

3. Develop a formal flood surveillance and warning plan.

4. Backfill, mulch, and seed slope erosion, animal burrows, and shallow depression located on embankment slopes and crest.

5. Repair, when necessary, spalled and cracked concrete surfaces on spillway channel sidewalls and reservoir drain control structure.



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Colonel, Corps of Engineers
District Engineer

LAUREL HILL LAKE DAM

OVERVIEW OF DAM

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PHASE 1 REPORT
NATIONAL DAM INSPECTION PROGRAM
LAUREL HILL LAKE DAM
NDI ID. NO. PA 267

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

A. AUTHORITY: This study was performed pursuant to the authority granted by the National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

B. PURPOSE: The purpose of this study is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

A. DAM AND APPURTENANCES

1. Embankment: Laurel Hill Lake Dam was constructed as a zoned earthfill structure. The dam embankment is approximately 700 ft. long, has a maximum toe to crest height of 32 ft., and a crest width of 13 ft. The upstream embankment slopes are 3H:1V from dam crest to top of riprap layer (El. 1943.5) and 2.5H:1V from El. 1943.5 to embankment toe. The downstream slope has an inclination of 2H:1V.

2. Seepage Control Provisions: A cutoff trench is located at dam centerline and extends the full length of the dam and spillway channel. The cutoff trench was constructed of impervious clay and extends about 10 ft. below the dam foundation. (Refer to Plate No. 5.)

   The downstream embankment toe was constructed with gravel and has been modified to include a rock and gravel filter drain at the location of the original Laurel Hill Creek stream channel (100 ft. north of the spillway channel). A 6 in. dia. tile drain has been installed in this section of the embankment toe to drain seepage collected by the filter. (Refer to Plate No. 1.)

3. Flood Discharge Facilities: Flood discharge facilities consist of an ungated, 115 ft. wide spillway channel and a 4 x 4 ft. reservoir drain culvert controlled by a slide gate.

   The spillway channel is located at the left dam abutment and consists of an ogee crest, a 30.5 ft. long channel, and a 52 ft. long concrete stilling basin. (Refer to Plate Nos. 1 and 5.)

According to construction drawings, a 4 x 6 ft. orifice is formed in the right spillway channel sidewall, 2 ft. upstream from the spillway ogee crest, and is protected by a trash rack. (Refer to Plate No. 2.) The 4 x 4 ft. concrete culvert extends 110 ft. to a concrete head wall, located about 30 ft. downstream from the end wall of the spillway channel stilling basin.

B. LOCATION: Laurel Hill Lake Dam is located in Laurel Hill State Park, Somerset County, Pennsylvania, less than one mile north of Trent and 4.3 miles northwest of New Centerville. The dam is situated on Laurel Hill Creek, a southward flowing tributary of the Casselman River. (Refer to Location Plan, Appendix E.)

C. SIZE CLASSIFICATION: The dam has a maximum top of dam storage capacity of 1,330 ac.-ft. and a toe to crest height of 32 ft. Based on maximum storage capacity, the dam is classified as an "intermediate" size structure.

D. HAZARD CLASSIFICATION: Laurel Hill Lake Dam is classified as a "high" hazard structure. In the event of dam failure approximately thirty (30) inhabited residences located within a 5.5 mile downstream channel reach would be subject to substantial damage and loss of life.

Additional property damage would be expected to occur to township roads, bridges, and a waste water treatment facility.

E. OWNERSHIP: Laurel Hill Lake Dam is owned by the Commonwealth of Pennsylvania, and as a State Park facility, its operation and maintenance are the responsibility of the Bureau of State Parks. All correspondence concerning maintenance and operation procedures should be directed to Resources Management Bureau, Department of Environmental Resources, P. O. Box 1467, Harrisburg, Pennsylvania 17120.

F. PURPOSE OF DAM: The dam was constructed for use as a recreational facility.

G. DESIGN AND CONSTRUCTION HISTORY: The dam was designed by the Branch of Recreational Planning and State Cooperation of the National Park Service (Department of the Interior) in 1937. Construction of the dam was completed in 1940.

A rehabilitation project, designed by the Pennsylvania Department of Forests and Waters in 1963 included construction of grouted stone gutters along the spillway channel sidewalls and a tile drain embedded in a rock and gravel filter, extending 100 ft. through the downstream embankment toe near the right spillway sidewall. (Refer to Plate No. 1.) Further modifications included repairing the concrete surfaces of the spillway sidewalls and reservoir drain control structure, replacing the slide gate lift mechanism, and restoring the dam crest surface. (Refer to Plate Nos. 2, 3, and 4.)

H. NORMAL OPERATING PROCEDURES: Laurel Hill Lake Dam normally operates as an uncontrolled structure with the reservoir drain slide gate closed. Pool elevation is maintained at El. 1938.5 by the ogee crest of the spillway channel.

1.3 PERTINENT DATA

A. DRAINAGE AREA	43.65 sq. mi.
B. DISCHARGE AT DAM FACILITY	
Maximum discharge at dam facility	Unknown
Maximum ungated spillway channel capacity	16,600 cfs
C. ELEVATION (FT. ABOVE MSL)	
Constructed top of dam	1950.0 ft.
Spillway channel crest	1938.5 ft.
Normal pool	1938.5 ft.
Maximum tailwater	Unknown
Invert of reservoir drain inlet	1915.0+ ft.
Invert of reservoir drain outlet	1913.0+ ft.
Streambed at dam centerline	1918.0+ ft.
D. RESERVOIR LENGTH	
Length of maximum pool	1.3 mi.
Length of normal pool	1.0 mi.
E. STORAGE CAPACITY	
Constructed top of dam	1330 ac.-ft.
Spillway channel crest	395 ac.-ft.
Normal pool level	395 ac.-ft.
F. RESERVOIR SURFACE AREA	
Constructed top of dam	84 acres
Spillway crest	58 acres
Normal pool	58 acres
Sediment pool	Unknown
G. DAM EMBANKMENT	
Type	Zoned Earthfill
Length	700 ft.
Height	32 ft.
Crest width	13 ft.
Side slopes	
Downstream	2H:1V
Upstream	
From toe to El. 1943.5	2.5H:1V
From El. 1943.5 to crest	3H:1V

G. DAM EMBANKMENT (Cont.)

Impervious core	Yes
Core cutoff trench	Yes
Grout curtain	None

H. SPILLWAY CHANNEL

Type	Ogee crest
Cross section	Rectangular
Width	115.0 ft.
Crest elevation	1938.5 ft.
Gate	None
Length of channel	30.5 ft.
Sidewall height above crest	12.0 ft.

I. RESERVOIR DRAIN

Type	4 x 4 ft. concrete culvert
Orifice	6 x 4 ft.
Outlet	5.5 x 4 ft.
Culvert length	110 ft.
Slope	2 percent
Gates	4 x 4 ft. slide gate stop log gate

J. STILLING BASIN

Type	Plunge pool
Apron	Concrete
Chute blocks	None
Baffle blocks	None
End sill	None
End cutoff wall	Yes
Length	52 ft.
Width	115 ft.
Depth of pool	4 ft.

SECTION 2
ENGINEERING DATA

2.1 DESIGN

A. DATA AVAILABLE: The following available data was obtained from the Pennsylvania Department of Environmental Resources, Dam Safety Division, Harrisburg, Pennsylvania.

1. Hydrology and Hydraulics: No design reports specific to Laurel Hill Lake Dam were available.

2. Dam and Appurtenances: The available data consists of one (1) design drawing prepared by the Branch of Recreational Planning and State Cooperation of the National Park Service (U. S. Department of the Interior) dated February 26, 1937, and four (4) preliminary design drawings prepared by the Pennsylvania Department of Forests and Waters. The National Park Service drawing shows the crest profile, sections of the embankment, spillway channel and sidewalls, and a proposed design change in riprap placement. The Department of Forests and Waters drawings include a site plan, section views of spillway sidewalls and the reservoir drain control structure, and details of appurtenances.

B. DESIGN FEATURES: Illustrations of principal design features are shown on Plate Nos. 1 through 5.

1. Embankment: According to the original design drawings, the zoned earthfill embankment rests on successive layers of sandy clay, clay, and shale above sandstone bedrock. Riprap on the upstream slope, placed between El. 1943.5 and El. 1933.5 is reportedly supported above the lake bottom by a compacted layer of gravel and clay. The hand-placed riprap provides protection to the embankment from erosion by wave action.

   The embankment clay core, located at the dam centerline tapers on a 1H:4V slope to an 8 ft. width at the dam crest.

2. Seepage Control Provisions: According to construction drawings, a cutoff trench was constructed as a continuation of the embankment core. The cutoff trench has a bottom width of 8 ft., 1H:2V side slopes, and extends to sandstone bedrock.

   Seepage control provisions also include a gravel and rock filter drain installed in the downstream embankment toe. This toe drain extends about 100 ft. from the right spillway

channel sidewall towards the right abutment. The drain consists of an 18 in. thick blanket of gravel supporting an 18 in. thick blanket of rock. A 6 in. tile drain pipe was installed in the toe of the filter drain to collect seepage and divert it to an open drainage ditch, located 35 ft. downstream of the dam embankment. Flow from the drainage ditch enters Laurel Hill Creek about 55 ft. downstream of the dam.

3. Flood Discharge Facilities: Details of the spillway channel and the reservoir drain culvert are shown on Plate Nos. 1 through 5.

   The spillway channel consists of an ogee crest, open channel, and stilling basin. Concrete sidewalls are 12 ft. high at the ogee crest. The rectangular stilling basin has a 52 ft. long reinforced concrete apron. The downstream end of the apron is sloped upward to maintain a 4 ft. deep pool in the stilling basin. Stone riprap has been hand-placed on both sides of the exit stream channel, and extends 30 ft. downstream. (Refer to Plate No. 1.)

   The invert of the reservoir drain inlet is El. 1915, approximately 1 ft. above lake bottom and 23.5 ft. below the lake surface during normal pool conditions. A stop log gate, slide gate, and manual lift mechanism are housed in a concrete control structure, located on the dam crest, at the embankment side of the right spillway sidewall. The stop log gate can be lowered to obstruct culvert flow and permit dewatering of the control structure for maintenance purposes. Access to the slide gate and lift mechanism is provided by an 8 ft. square opening with a steel grate cover located on top of the control structure.

   Flow from the reservoir drain exits at a concrete head wall located about 30 ft. downstream from the end wall of the stilling basin. The 5.5 x 4 ft. outlet is submerged and the flow is discharged directly into Laurel Hill Creek.

2.2 CONSTRUCTION: Field observations indicate that the dam was constructed in general accordance with available construction drawings. There is no record of any additional modifications made to the dam after renovations were made in 1964.

2.3 OPERATION: The Commonwealth of Pennsylvania, Bureau of State Parks, is responsible for the operation of Laurel Hill Lake Dam. The dam is generally operated as an uncontrolled structure and no performance records are maintained. The only operational feature is a manually operated slide gate reportedly inspected annually. This slide gate was not operated during the field reconnaissances.

2.4 EVALUATION

A. AVAILABILITY: All available construction information and drawings were provided by the Pennsylvania Department of Environmental Resources, Dam Safety Division, Harrisburg, Pennsylvania.

B. ADEQUACY: The construction drawings and design data provided are reasonably documented and are considered adequate to evaluate the dam and appurtenant structures in accordance with the scope of a Phase 1 study. Based on the review of this data, the dam and appurtenant structures are considered to have been designed in general conformance with accepted engineering practice.

C. VALIDITY: At this time, there is no observable evidence or reason to question the validity of the available construction information and drawings.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

A. GENERAL: The on-site reconnaissance of Laurel Hill Lake Dam consisted of:

1. Visual observations of the earth embankment, abutments, and spillway channel.

2. Visual observations of exposed sections of the reservoir drain culvert, slide gate control structure, reservoir, and downstream channel.

3. Visual observations of discernible hazardous conditions or safety deficiencies.

4. Evaluation of the downstream hazard potential.

5. Transit stadia survey of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes.

Visual surveys were performed during periods when reservoir and tailwater were at normal pool levels.

A visual observation check list and field sketch are given in Appendix A. Specific observations are illustrated in photographs of Appendix C.

B. EMBANKMENT

1. Embankment Surface: Upstream embankment slope has a dense grass covering and hand-placed rock riprap extending from normal pool level to about El. 1943.5. An eroded footpath is located about 160 ft. south of the right abutment and extends from normal pool level to dam crest and down the downstream embankment slope. Animal burrows were found on both embankment slopes at locations shown on the field sketch in Appendix A. A shallow depression is located in front of the reservoir drain control structure on the dam crest. The downstream embankment slope has a dense grass covering and a Department of Forest and Water boundary marker located at about mid-slope approximately 100 ft. north of the spillway channel. Field survey measurements indicate the downstream embankment slope is inclined 2H:1V, whereas the upstream embankment slope is inclined 3H:1V from dam crest to top of riprap layer (El. 1943.5), and 2.5H:1V from top of riprap to normal pool level. A gravel access road, frequently used during the summer months, is located at the right upstream embankment-abutment junction.

2. Seepage Zone: A seep and an adjoining wet zone were observed located about 45 ft. below the downstream embankment toe and about 200 ft. north of the spillway-stilling basin. The seep was observed to discharge clear water at an estimated flow rate of 8 gpm. Reportedly the seep and wet zone have existed for several years and are believed the result of spring activity.

   The seep and adjoining wet zone are located in a topographic low near the location of the old stream channel, and drain in a direction towards Laurel Hill Creek.

C. APPURTENANT STRUCTURES

1. Spillway Channel: Spillway channel crest, bottom, and sidewalls are of concrete construction and appear structurally sound. However, minor evidence of spalling and cracking was observed on exposed sections of the spillway channel sidewalls. Also, an eroded footpath extends along the upstream spillway-abutment junction sidewall. Concrete gutters are located along both downstream sidewalls of the spillway channel.

   Spillway channel inlet, outlet, and stilling basin were found free of significant debris and flow obstructions.

2. Outlet Works: Exposed sections of the reinforced concrete reservoir drain control structure appeared in good condition. However, some evidence of spalling and cracking was apparent on exterior concrete surfaces.

   Reservoir drain culvert inlet and outlet were submerged and could not be observed.

   Reservoir drain slide gate and lifting mechanisms were not operated during the field reconnaissances. However, the slide gate and lifting mechanisms are reportedly operational.

D. RESERVOIR AREA: No evidence of significant slope instability or shoreline erosion was observed during the field reconnaissances. Reservoir slopes have gentle to moderate inclinations and are predominately covered with trees and thick vegetation. Sediment from reservoir side slopes and beach areas are occasionally washed into the reservoir during heavy surface runoff.

E. DOWNSTREAM CHANNEL: The spillway channel stilling basin discharges into an outlet channel approximately 100 ft. in width. Outlet channel bottom is cobble lined, with side slopes covered by grass and tree growth. The downstream channel appeared stable and was found free of debris and flow obstructions. Approximately thirty (30) inhabited structures are located within an estimated 15 ft. elevation difference of Laurel Hill Creek within a 5.5 mile channel reach between the dam and Barronvale, Pennsylvania.

3.2 EVALUATION

A. EMBANKMENT

1. Embankment Surface: In general, the dam embankment is adequately maintained and appears in good condition. The eroded footpath, animal burrows, and shallow depression observed on embankment slopes and crest are surficial deficiencies and are not considered to represent significant hazard to the dam. However, remedial repairs should be made as soon as possible.

2. Seepage Zone: Although believed attributable to spring activity, the cause and origin of the observed seepage could not be conclusively established by visual observation and review of construction documents. It is therefore recommended the seep and adjoining wet zone be periodically monitored by the dam owner to note any change in conditions. If an increase in flow quantity or evidence of erosion is observed, the Department of Environmental Resources, Dam Safety Division should be notified immediately and necessary corrective repairs made.

B. APPURTENANT STRUCTURES: The spillway channel and stilling basin appear to be functioning as designed and are considered to be in good condition. Spalling and cracking of channel side-wall and control structure surfaces should be visually observed on a periodic basis and corrective repairs made as necessary.

SECTION 4
OPERATIONAL FEATURES

4.1 PROCEDURE: Reservoir level is normally maintained at El. 1938.5 by passage of base flow over the ogee crest of the spillway channel. Since the dam routinely operates as an uncontrolled structure, a dam tender is not required. The only control features of the dam are a slide gate and stop log gate which are used to regulate the reservoir drain culvert. The slide gate is infrequently operated and is normally closed. The gate can be inspected at normal pool by lowering the stop log gate and dewatering the control structure.

4.2 MAINTENANCE OF DAM: The dam embankment and appurtenant structures are maintained by the Pennsylvania Bureau of State Parks. Normal maintenance usually includes mowing the embankment slopes, applying seed and fertilizer, and servicing the reservoir drain gates and lift mechanisms. Maintenance is reportedly performed on an "as-needed" basis.

4.3 INSPECTION OF DAM: Inspections of Laurel Hill Lake Dam are conducted annually by the Pennsylvania Bureau of State Parks and biennially by the National Park Service. Inspections generally consist of visual observations of the embankment and appurtenant structures and providing repair recommendations.

4.4 MAINTENANCE OF OPERATING FACILITIES: The reservoir drain slide gate and stop log gate are the only operational features of the dam. The reservoir drain gates are normally inspected and operated annually by State Park personnel. Both gates were found closed and were not operated during field reconnaissances made prior to this report. However, the gates are reported to be operable and in good condition.

4.5 WARNING SYSTEM: The Park Superintendent reportedly monitors the dam facility during periods of unusually heavy rainfall and alerts Civil Defense authorities as required. However, no formal flood warning plan is in effect.

4.6 EVALUATION: With the exception of no formally instituted flood warning plan, the current operational and maintenance procedures at Laurel Hill Lake Dam are considered to be adequate. A formal flood warning and evacuation plan is needed for the protection of park users and downstream residents.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. DESIGN DATA: The watershed of Laurel Hill Lake Dam has an area of approximately 28,000 acres and ranges in topographic relief from normal pool El. 1938.5 to El. 2980. Watershed cover complex is approximately 60 percent forest and 40 percent open pasture and farmland. Among the lakes and ponds located upstream from Laurel Hill Lake Dam are three ski area "snow making" ponds, two fish hatchery networks, Laurelridge Lake, Kooser Lake, the Bakersville Reservoir, and two unnamed lakes south of Pennslyvania Route 31 near Jimtown. These identified bodies of water are not considered to have a significant effect on the safety or performance of the dam.

At normal pool, Laurel Hill Lake Dam impounds a reservoir with a surface area of 58 acres and a storage volume of about 395 ac.-ft. Top of dam storage capacity is approximately 1,330 ac.-ft.

B. EXPERIENCE DATA: Records are not kept of reservoir stage elevations or rainfall amounts. There is no report of the dam embankment ever having been overtopped.

As previously stated, Laurel Hill Lake Dam is classified as an "intermediate" size, "high" hazard dam. According to guidelines established by the U. S. Army Corps of Engineers, the required spillway design flood (SDF) for this dam facility is the Probable Maximum Flood (PMF).

The PMF inflow hydrograph for Laurel Hill Lake was modeled using the HEC-1 Dam Safety Version computer program. This hydrograph was routed through the reservoir and dam spillway and produced a calculated PMF peak outflow rate of 50,500 cfs. Computer input data and summary of output are presented in Appendix D.

C. VISUAL OBSERVATIONS: No serious deficiencies or other adverse conditions were observed during the field reconnaissances that would significantly reduce spillway discharge capacity or prevent the channel from functioning as designed.

D. OVERTOPPING POTENTIAL: Various percentages of PMF were routed through the reservoir to estimate the percent PMF outflow that the spillway can adequately pass without overtopping the dam. Computer analyses indicate that the spillway channel can hydraulically pass a maximum of about 34 percent of the PMF without overtopping the dam. The analyses also indicate that Laurel Hill Lake Dam is overtopped for a period of 6 hours with a maximum depth of 2.44 ft. for 50 percent PMF conditions. PMF runoff overtops the dam for 13.5 hours and produces an estimated maximum overflow depth of 6.2 ft.

E. ADEQUACY OF SPILLWAY CHANNEL

1. General: Spillway adequacy was evaluated in accordance with procedures and guidelines established by the U. S. Army Corps of Engineers for Phase 1 hydrologic and hydraulic studies.

   As previously indicated by the overtopping potential analysis, the spillway channel does not have adequate capacity to pass the recommended spillway design flood of 100 percent PMF without overtopping the dam. Guideline criteria requires that an estimate of the likelihood of dam failure and an assessment of downstream damage and loss of life consequences be made for dams overtopped by less than 50 percent PMF conditions.

   The HEC-1 Dam Safety Version computer program was used to evaluate breaching of the dam and to estimate the downstream hydrologic/hydraulic consequences of assumed structural failures caused by overtopping. This data was used to assess the adequacy of the spillway channel.

2. Method of Analysis: A breach analysis was conducted to estimate if dam failure resulting from overtopping would significantly increase loss of life or property damage downstream from the dam compared to what would exist just before dam failure. This analysis was performed in three steps:

   a. Step 1: A failure storm of 37 percent PMF was selected to initiate breaching of the dam.

   b. Step 2: The selected 37 percent PMF hydrograph was routed through Laurel Hill Lake and downstream damage centers to provide an estimate of flood stages prior to incipient failure of the dam. These flood stages served as a reference level of damage and were compared to those produced during the breach analysis.

   c. Step 3: Breach flood stages at the designated damage centers were estimated by routing the 37 percent PMF inflow hydrograph combined with the discharge contributed by failure of the dam. The breach analysis was based on the following data:

1)	Depth of overtopping flow at onset of failure	0.75 ft.
2)	Breach bottom width	70 ft.
3)	Maximum breach top width	85 ft.
4)	Maximum breach height	30 ft.
5)	Duration of failure	0.5 hrs.

3. Results: Computer analyses indicate downstream flood stages would be raised by between 4.1 and 6.3 ft. by the assumed dam breach (refer to Summary of Flood Stages for 37 Percent PMF, D-11 in Appendix D).

Field reconnaissance and map review indicate that dam failure, according to the selected breach model, will increase flood stages enough to inundate two (2) residences in the vicinity of Sta. 1 and one (1) residence at Sta. 2. Furthermore, seven (7) residences located downstream from Sta. 4 are expected to experience a significant increase in loss of life and damage potential for dam breach conditions. (Refer to Location Plan in Appendix E for damage center station locations.)

Based on the above data, breach flood flows are considered to significantly increase the loss of life and the downstream damage potential. Accordingly, spillway channel discharge capacity is assessed to be seriously inadequate.

SECTION 6
STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. VISUAL OBSERVATIONS

1. Embankment: Surficial embankment deficiencies identified in Section 3.1-B1 are not considered to have a significant effect on dam stability. However, the observed seepage and adjoining wet zone located about 45 ft. from the downstream embankment toe and about 200 ft. north of the spillway channel (refer to Field Sketch, Appendix A) are considered to represent a potential hazard to the dam. The cause and origin of the seepage could not be conclusively determined by visual observation and review of construction drawings. However, the seep and wet zones, in their present condition, are not considered to represent a significant hazard to the dam at this time. Periodic monitoring of the zones by the dam owner is recommended.

2. Appurtenant Structures: Except for some evidence of minor concrete spalling, no significant evidence of structural distress was observed during the field reconnaissances that would significantly affect hydraulic performance or the stability of the dam.

B. DESIGN AND CONSTRUCTION DATA

1. Subsurface Exploration: No subsurface exploration reports were available. According to the original design drawing (Plate No. 5), the embankment cutoff trench was excavated through layers of sand clay, clay, and shale to sandstone bedrock.

2. Laboratory Testing: No laboratory test reports were available, nor was any reference made to laboratory testing in the available information.

3. Slope Stability Analysis: No calculations or references to slope stability analyses were found in available source material. Based upon embankment geometry, visual observations, and performance history, the static slope stability of the embankment is presumed adequate.

4. Seepage Analysis: No calculations or references to seepage analysis were found in the available information.

C. OPERATING RECORDS: The only operating features are the reservoir drain gates which are normally closed. Operating records are not maintained at the dam facility, but reportedly the slide gate is presently operational and is exercised annually.

D. POST-CONSTRUCTION CHANGES: Preliminary design drawings dated 1963, suggest that repairs, including the installation of steel reinforcement, were made to the concrete surfaces of the spillway channel sidewalls and reservoir drain control structure (refer to Plate Nos. 1 through 4).

Additional improvements included the construction of grouted stone gutters along the spillway channel sidewalls, construction of a 10 ft. wide drainage ditch parallel to the downstream embankment toe, and restoration of the dam crest surface.

E. SEISMIC STABILITY: The dam is located in Seismic Zone 1 (low seismic probability). No calculations or references of embankment stability were found. Based upon this low seismic probability and recommended criteria for the evaluation of the seismic stability of dams, the seismic stability of the embankment is presumed to be adequate under these earthquake conditions.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. EVALUATION

1. Embankment: The cause and origin of the observed seepage zone could not be conclusively established by visual observation and review of construction drawings. It is therefore recommended the seep and adjoining wet zone be periodically monitored by the dam owner to note any change in condition. Embankment surface deficiencies presented in Section 3.2-A are surficial in scope and are not considered to represent significant hazard to the dam. However, remedial repairs are recommended. In general, dam embankment crest and slopes are adequately maintained, and appear in good condition at the present time.

2. Appurtenant Structures: In general, the spillway channel, stilling basin, and reservoir drain control structure are assessed in good condition at the present time. Remedial repair of spalling and cracking of concrete surfaces should be made as necessary.

3. Overtopping Potential: U. S. Army Corps of Engineers dam safety criteria recommends a PMF spillway design flood for "intermediate" size, "high" hazard dams. HEC-1 Dam Safety Version computer analyses indicate the spillway channel can pass approximately 34 percent PMF without overtopping the dam. Analysis indicates PMF inflow will cause a 6 ft. overtopping for an estimated flow duration of 13.5 hours.

4. Spillway Adequacy: As presented in Section 5, overtopping of the dam by 37 percent PMF inflow is reasonably expected to cause dam failure. HEC-1 Dam Safety Version computer analyses indicate downstream flood stages would be raised by between 4.1 to 6.3 ft. in the event of the assumed dam failure. This increase in flood stage level is considered to significantly increase the loss of life and potential downstream damage. Therefore, the discharge capacity of the spillway channel is considered to be seriously inadequate. The dam is accordingly categorized as "unsafe, non-emergency" based on guideline criteria.

B. ADEQUACY OF INFORMATION: The construction drawings available for this review were of sufficient detail to adequately conduct a Phase 1 study.

C. NECESSITY FOR FURTHER INVESTIGATION: The dam owner should initiate additional studies by a professional engineer experienced in the design of dams to more accurately ascertain spillway channel adequacy and the extent of improvements required to provide sufficient discharge capacity or erosion/breaching protection for the dam.

D. URGENCY: The following recommendations should be implemented as soon as possible.

7.2 RECOMMENDATIONS: The following recommendations are presented based on the data obtained:

A. DAM AND APPURTENANT STRUCTURES

1. Implement additional studies by a professional engineer experienced in the design of dams to more accurately ascertain spillway channel adequacy and the extent of improvements required to provide sufficient discharge capacity or erosion/breaching protection for the dam. Improvements found necessary by the recommended study should be implemented immediately.

2. Monitor seepage and adjoining wet zone located at downstream embankment toe. If increased flow quantity or evidence of erosion is observed, the Department of Environmental Resources, Dam Safety Division should be notified immediately, and necessary corrective repairs made.

3. Backfill, mulch, and seed slope erosion, animal burrows and shallow depression located on embankment slopes and crest.

4. Repair, when necessary, spalled and cracked concrete surfaces on spillway channel sidewalls and reservoir drain control structure.

B. OPERATION AND MAINTENANCE PROCEDURES

1. Develop a formal flood surveillance and warning plan. Plan to include, but not limited to, the following:

a) Surveillance: Around-the-clock surveillance of spillway channel discharge and overtopping of dam during periods of unusually heavy rainfall.

b) Warning System: Formal warning procedures to alert downstream residents in the event of expected high flood flows.

c) Evacuation Plans: Adequate emergency contingency plans to evacuate downstream residents in the event or threat of a dam failure.

2. Periodically observe seepage zone and adjoining wet zone located downstream of dam embankment.

APPENDIX A

VISUAL OBSERVATIONS CHECK LIST AND FIELD SKETCH

VISUAL OBSERVATION CHECK LIST

Name Dam Laurel Hill Lake Dam County Somerset State Pennsylvania National ID # PA 267

Type of Dam Earthfill Hazard Category Class I - High Hazard

Date(s) Inspection 11/20/79 Weather Clear Temperature 50°

Inspection Review Date March 4, 1980

Pool Elevation at Time of Inspection 1938.5 Tailwater at Time of Inspection Normal M.S.L.

Inspection Personnel:

Ackenheil & Associates
Timothy Debes
Rick Gabell
James Hannan
James Hainley
Michael McCarthy
John Schultz

Bureau of State Parks
Victor Prokop

Recorder Timothy Debes

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS*
SURFACE CRACKS	None observed. Embankment crest and slopes have a dense grass covering.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Eroded footpath located 160 ft. south of right abutment on the upstream embankment slope.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No significant vertical or horizontal misalignment observed.	
RIPRAP FAILURES	None observed.	

*REFER TO REPORT SECTIONS 3 AND 7

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SETTLEMENT	Shallow depression located in front of reservoir drain control structure on dam crest.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Gravel access road located at upstream embankment-abutment junction. Surface slope erosion along upstream and downstream spillway-abutment junctions.	
ANY NOTICEABLE SEEPAGE	Seep and adjoining wet zone observed located 45 ft. downstream of dam. The seep had a clear discharge at an estimated flow rate of 8 gpm.	
STAFF GAGE AND RECORDER	None.	
DRAINS	A six (6) in. dia. tile drain pipe was installed in the downstream embankment toe filter extending 100 ft. north from the spillway-embankment junction.	

OUTLET WORKS

(Reservoir Drain)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Minor spalling and cracking evident on concrete surfaces of reservoir drain control structure.	
INTAKE STRUCTURE	Submerged.	
OUTLET STRUCTURE	Rectangular concrete culvert opening, exiting the right downstream spillway side wall. Field measurements indicate an outlet opening of 4 x 5.5 ft.	
OUTLET CHANNEL	Outlet stream channel is cobble lined with vegetated banks. Channel observed free of debris and flow obstruction.	
EMERGENCY GATE	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Ogee crested weir.	
APPROACH CHANNEL	Approach channel observed free of debris and flow obstructions.	
DISCHARGE CHANNEL	Fifty-two ft. long concrete stilling basin with concrete sidewalls and reinforced concrete apron.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY (NOT APPLICABLE)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

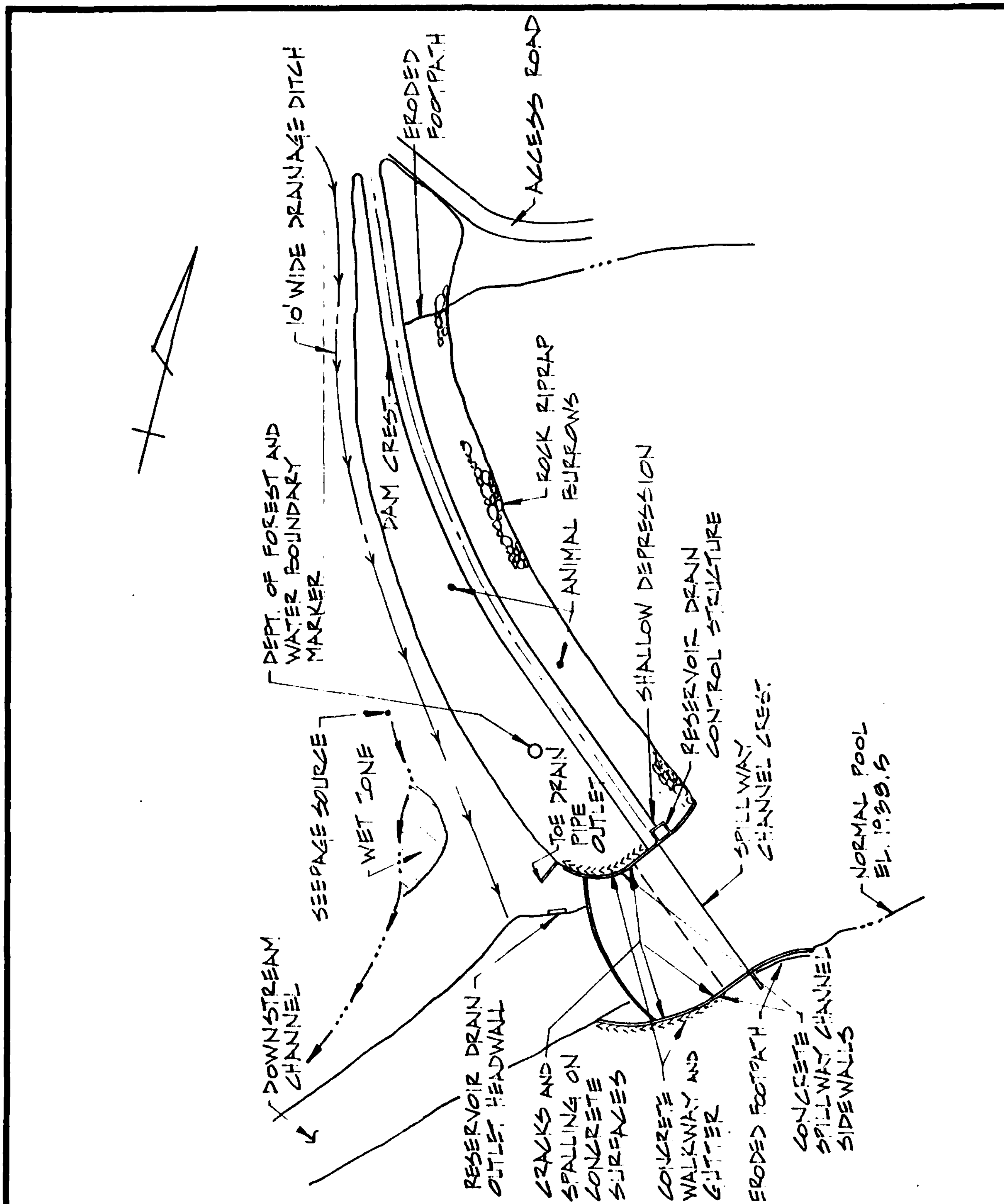
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Department of Forest and Water boundary marker located on downstream embankment slope, approximately 100 ft. north of spillway-embankment junction.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	N/A	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Reservoir slopes are vegetated primarily by forest, appear stable, and have gentle to moderate inclinations. No evidence of landslides or significant shoreline erosion was observed.	
SEDIMENTATION	Sediment transported from beach areas into reservoir during heavy runoff. Reservoir and spillway discharge water observed clear.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	None observed.	
SLOPES	Channel side slopes are vegetated with grass and woody shrubs and appear stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately thirty (30) inhabited structures are located within the estimated downstream flood plain between the dam site and Barronvale, Pennsylvania.	

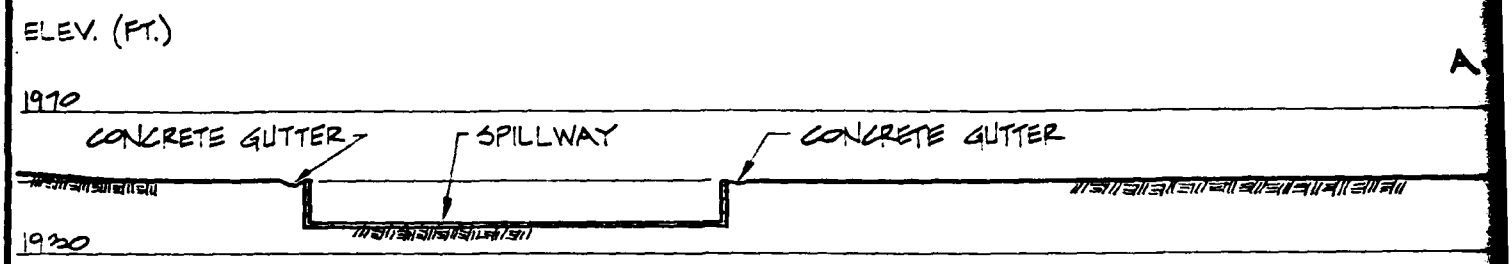


DATE: MARCH 21, 1980
SCALE: NONE
DR: JLM CK: TED
DWG. NO. A-10

NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES
CONSULTING ENGINEERS
BALTIMORE, MD.

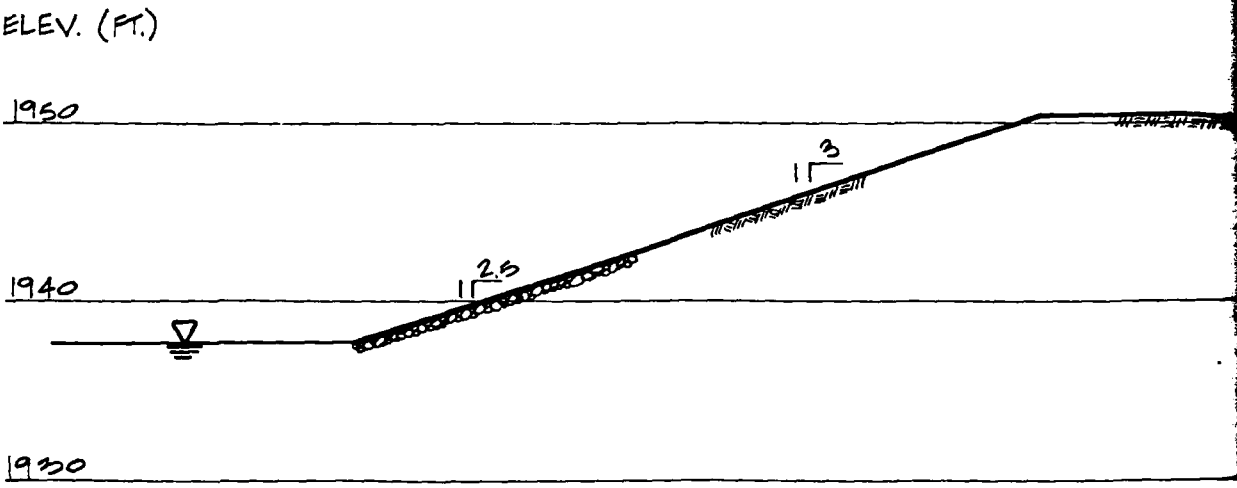
LAUREL HILL LAKE DAM FIELD SKETCH



A

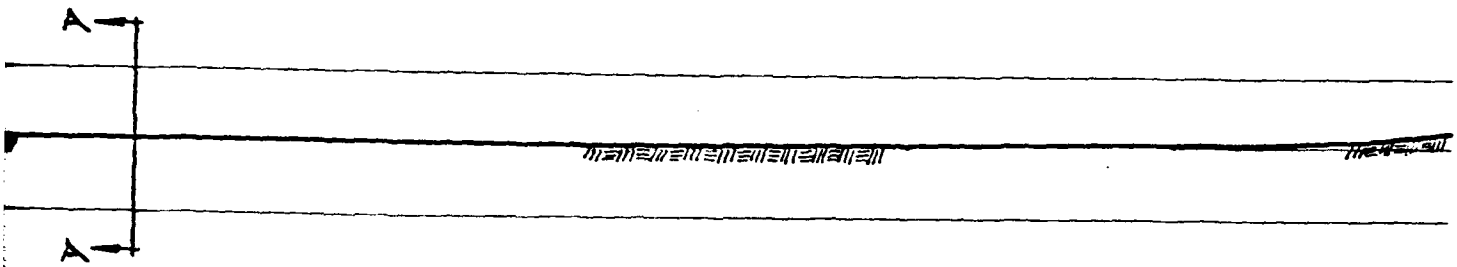
A

DAM CREST PR
1"=50'

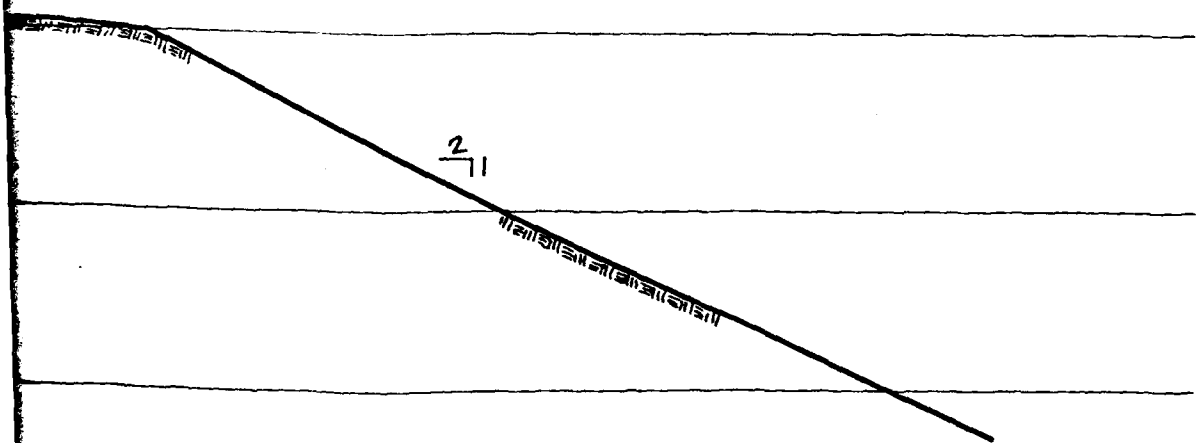


SECTION A-
1"=10'

NOTE:
ASSUMED DATUM ELEV. 1938.5 ON TOP OF OGEE CREST



PROFILE



A-A

DATE: MARCH 21, 1980	NATIONAL DAM INSPECTION PROGRAM	LAUREL HILL LAKE DAM
SCALE: AS SHOWN		
DR: JLM CK: JGS	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS BALTIMORE, MD.	
DWG. NO. A-11		

APPENDIX B

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

NAME OF DAM Laurel Hill Lake Dam

ID # PA 267

ITEM	REMARKS
AS-BUILT DRAWINGS	No as-built drawings are available. Construction drawings were provided by the Pennsylvania Department of Environmental Resources, Dam Safety Division (see Plate Nos. 1-5).
REGIONAL VICINITY MAP	See Appendix E, Sections of four (4) U.S.G.S. 7.5 min. quadrangle maps showing dam site location.
CONSTRUCTION HISTORY	Construction drawing(s) prepared by the Branch of Recreational Planning and State Cooperation of the National Park Service (Department of the Interior) dated February 26, 1937. Construction of the dam was completed in 1940. Construction drawings for a rehabilitation project were prepared by the Pennsylvania Department of Forests and Waters in 1963. Construction of the rehabilitation project was completed in 1964.
TYPICAL SECTIONS OF DAM	See Plate No. 5 and Drawing No. A-11.
OUTLETS - PLAN	Reservoir drain and spillway channel - see Plate Nos. 1-5.
DETAILS	
CONSTRAINTS	Highway bridge located 3000 ft. downstream from dam.
DISCHARGE RATINGS	None available.
RAINFALL/RESERVOIR RECORDS	None available.

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	The following modifications were proposed by preliminary design drawings in 1963: construction of grouted stone gutters along spillway channel sidewalls, installation of 100 ft. rock and gravel filter and toe drain, installation of steel reinforcing and concrete surface repair of spillway channel sidewalls and reservoir drain control structure, replacing the slide gate control mechanisms, and restoration of the dam crest surface.
HIGH POOL RECORDS	None reported.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None reported.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	Inspections reportedly performed annually by park superintendent and biennially by the National Park Service. However, no reports were available.

ITEM	REMARKS
SPILLWAY PLAN	See Plate No. 1.
SECTIONS	See Plate Nos. 2, 3 and 5.
DETAILS	See Plate Nos. 2, 3 and 5.
OPERATING EQUIPMENT PLANS & DETAILS	See Plate Nos. 1, 2 and 4.
SPECIFICATIONS	None available.
MISCELLANEOUS	Assumed datum El. 1938.5 on top of ogee crest.

APPENDIX C

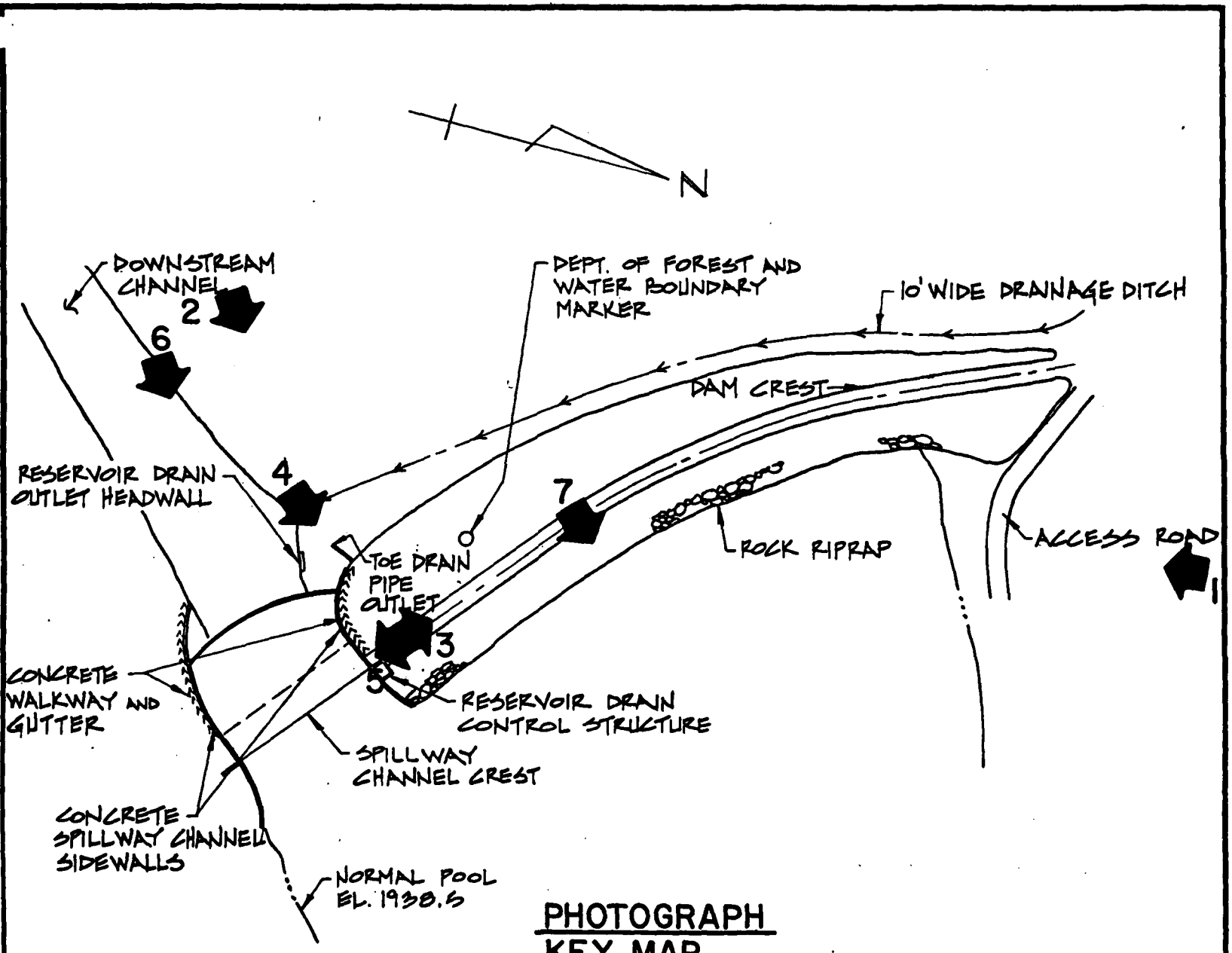
PHOTOGRAPHS

DATE: MARCH 21, 1980
SCALE: NONE
DR: JLM | CK: TED
DWG. NO. C-1

NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES
CONSULTING ENGINEERS
BALTIMORE, MD.

LAUREL HILL LAKE DAM SITE



PHOTOGRAPH KEY MAP

PHOTOGRAPH 1	View of upstream embankment slope from right abutment.
PHOTOGRAPH 2	View of downstream embankment slope and spillway channel sidewall looking upstream.
PHOTOGRAPH 3	Overview of dam crest from spillway-embankment junction.
PHOTOGRAPH 4	Seepage toe drain outlet.

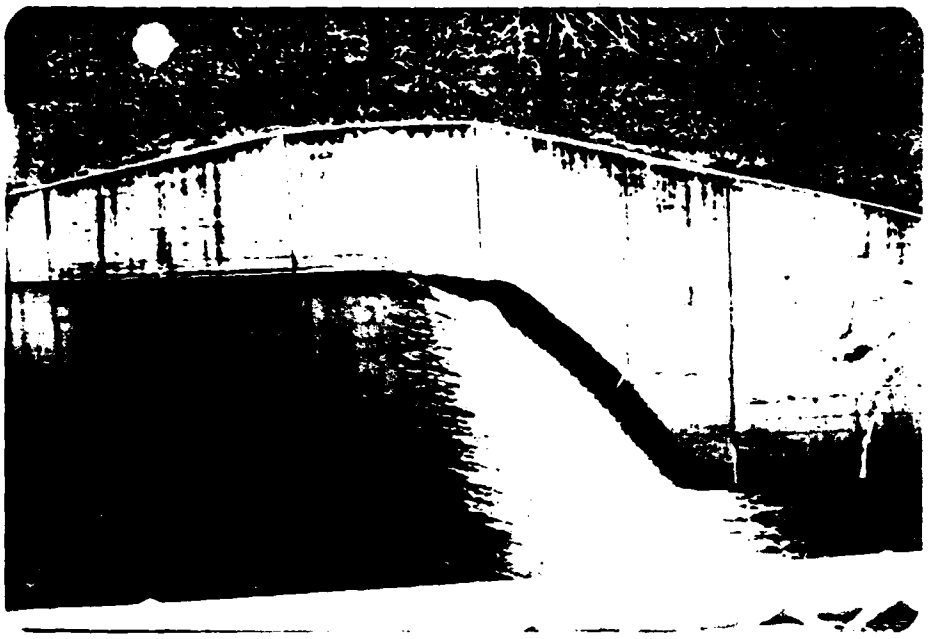
1

2

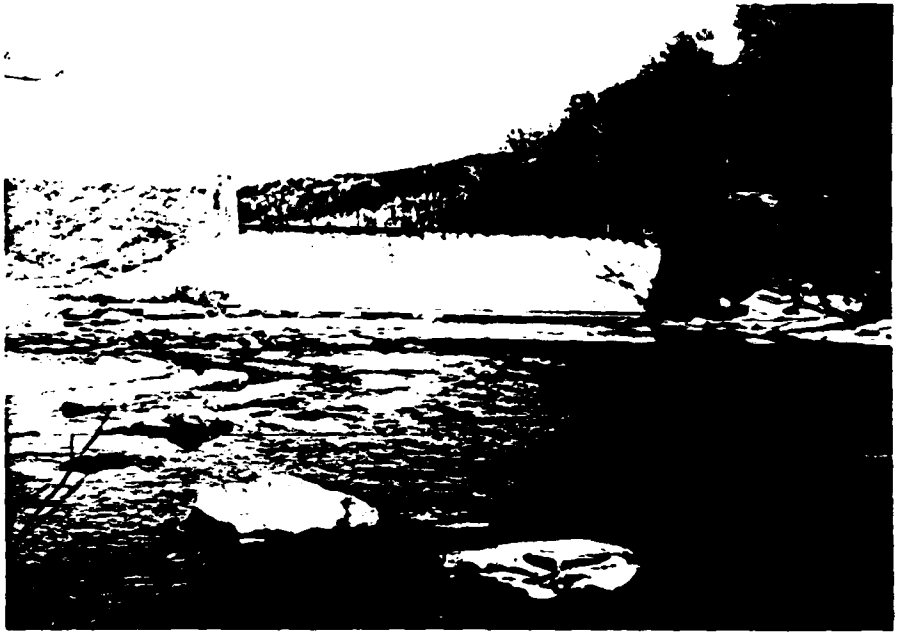
3

4

PHOTOGRAPH 5	View of spillway channel ogee crest and left sidewall. Note spalling and cracking on concrete surface.
PHOTOGRAPH 6	View of spillway channel and stilling basin looking upstream.
PHOTOGRAPH 7	Overview of reservoir and watershed.
PHOTOGRAPH 8	Downstream hazard at Station 1.



5



6

7

8

APPENDIX D

HYDROLOGIC AND HYDRAULIC ENGINEERING AND COMPUTER DATA

HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Approximately 60% forest and 40% open pasture and cropland

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1938.5 ft. (395 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1950.0 ft. (1330 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: 1950.0 ft.

ELEVATION TOP DAM: 1950.0 ft.

SPILLWAY CHANNEL

a. Elevation Ogee crest at El. 1938.5
b. Type Rectangular-shaped, concrete channel
c. Width 115 ft. at Ogee crest
d. Length 30.5 ft.
e. Location Spillover Left (south) abutment
f. Number and Type of Gates None

RESERVOIR DRAIN

a. Type 4 x 4 ft. concrete culvert
b. Location through and along right (north) spillway channel sidewall
c. Entrance Inverts El. 1915.0
d. Exit Inverts El. 1913.0
e. Emergency Drawdown Facilities Manually-operated slide gate housed in concrete control structure at dam crest adjacent to right (north) spillway channel sidewall.

HYDROMETEOROLOGICAL GAGES

a. Type None
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE 16,600 cfs

HEC-1-DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM:	Laurel Hill Lake Dam
Probable Maximum Precipitation (PMP)	24.0 in.*
Drainage Area	43.65 sq. mi.
Reduction of PMP Rainfall for Data Fit Reduce by 15.4% therefore PMP rainfall =	20.3 in.
Adjustments of PMF for Drainage Area	
6 hrs.	87%
12 hrs.	105%
24 hrs.	115%
48 hrs.	125%
Snyder Unit Hydrograph Parameters	
Zone	25**
C_p	0.40
C_t	1.0
L	12.4 mi.
L_{ca}	6.12 mi.
$t_p = C_t (L \cdot L_{ca})^{0.3} =$	3.66 hrs.
Loss Rates	
Initial Loss	1.0 in.
Constant Loss Rate	0.05 in./hr.
Base Flow Generation Parameters	
Flow at Start of Storm	1.5 cfs/sq. mi. = 65.5 cfs
Base Flow Cutoff	0.05 Q_p
Recession Ratio	2.0
Spillway Channel Section	
Crest Length	115 ft.
Sidewall Height	12 ft.
Discharge Coefficient	3.7
Exponent	1.5
Discharge Capacity	16,600 cfs
Breach Parameters	
Section Width (Bottom)	70 ft.
Section Height	30 ft.
Duration of Failure	0.5 hrs.
Depth of Maximum Overtopping Prior to Failure	0.75 ft.

*Hydrometerological Report 33
**Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

BY JGS
DATE 17 MAR 80
CHECKED TCD
DATE 21 MAR 80

ACKENHEIL & ASSOCIATES
CONSULTING ENGINEERS
FAIRFAX, VIRGINIA

JOB NO 79067

SUBJECT: LAUREL HILL LAKE STORAGE VERSUS WSEL
LAUREL HILL LAKE DAM

SHEET NO 1 OF 1

1) LAKE SURFACE AREAS DETERMINED BY PLANIMETER OF CONTOURS OF 7½' USGS QUAD SHEETS EXCEPT FOR WSEL = 1920', WHICH WAS ESTIMATED FROM 15' QUAD SHEET.

2) USING CONIC SECTION METHOD,

$$\Delta V = \frac{h}{3}\left(A_1 + \sqrt{A_1 A_2} + A_2\right)$$

WHERE $h = (WSEL)_2 - (WSEL)_1$

WSEL (ft.)	h (ft)	AREA (ac.)	ΔV (AF)	V (AF)
1914.0		0		0
	6		1.0	
1920		0.5		1
	18.5		394	
1938.5		58		395
	21.5		1747	
1960		107		2141

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1              A1              NON-BREACH ANALYSIS OF LAUREL HILL LAKE DAM
    2              A2                MIDDLECREEK TWP.       SOMERSET CO., PA.
    3              A3              SNYDER UH., RATIOS OF PMF, & MOD PULS ROUTING
    4              B    300        0      30       0       0       0       0       0      -4
    5              B1     5        0       0
    6              J      1        9       1
    7              J1   0.2      0.3    0.33    0.35    0.37    0.40    0.50    0.75     1.0
    8              K      0     LAKE                                      1
    9              K1       COMPUTATION OF INFLOW HYDROGRAPH TO LAUREL HILL LAKE
   10              M      1        1   43.65       0       0       0                       1
   11              P      0     24.0      87     105     115     125
   12              T      0        0       0                                   1    0.05
   13              W   3.66      0.4       0
   14              X   -1.5    -0.05     2.0
   15              K      1      DAM                                          1
   16              K1       MOD PULS ROUTING OF FLOW THROUGH LAUREL HILL DAM
   17              Y      0        0       0       1       1
   18              Y1     1        0       0       0                     395
   19              $S     0        1     395    2140
   20              $E  1914     1920  1938.5    1960
   21              $$1938.5      115     3.7     1.5
   22              $D  1950      3.1     1.5      46
   23              $L    46      170     335     430     470     550     620
   24              $V  1950   1950.5  1951.2    1952  1952.6    1955    1960
   25              K     99
```

COMPUTER INPUT - OVERTOPPING ANALYSIS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1938.50	1938.50	1950.00
STORAGE	395.	395.	1328.
OUTFLOW	0.	0.	16594.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1946.66	0.00	1057.	9916.	0.00	44.00	0.00
.30	1949.23	0.00	1266.	14948.	0.00	44.00	0.00
.33	1949.94	0.00	1323.	16458.	0.00	44.00	0.00
.35	1950.38	.38	1359.	17488.	2.00	44.00	0.00
.37	1950.77	.77	1391.	18531.	3.00	44.00	0.00
.40	1951.25	1.25	1429.	20068.	4.00	44.00	0.00
.50	1952.44	2.44	1526.	25164.	6.00	43.50	0.00
.75	1954.54	4.54	1697.	37848.	11.00	43.50	0.00
1.00	1956.20	6.20	1831.	50507.	13.50	43.50	0.00

COMPUTER OUTPUT - SUMMARY OF OVERTOPPING ANALYSIS

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

    1  A1 BREACH & NON-BREACH ANALYSIS OF LAUREL HILL LAKE DAM WITH DOWNSTREAM ROUTING
    2  A2                  MIDDLECREEK TWP.       SOMERSET CO., PA.
    3  A3              SNYDER UH., RATIOS OF PMF, & MOD PULS ROUTING
    4  B    300       0      30       0       0       0       0       0      -4       0
    5  B1     5       0       0
    6  J      2       2       1
    7  J1  0.37     0.5
    8  K      0    LAKE                                       1
    9  K1       COMPUTATION OF INFLOW HYDROGRAPH TO LAUREL HILL LAKE
   10  M      1       1   43.65       0       0       0                               1
   11  P      0    24.0      87     105     115     125
   12  T      0       0       0                               1    0.05
   13  W   3.66     0.4       0
   14  X   -1.5   -0.05     2.0
   15  K      1     DAM                                       1
   16  K1       MOD PULS ROUTING OF FLOW THROUGH LAUREL HILL DAM
   17  Y      0       0       0       1       0
   18  Y1     1       0       0       0                     395
   19  $S     0       1     395    2140
   20  $E  1914    1920  1938.5    1960
   21  $$1938.5     115     3.7     1.5
   22  $D  1950     3.1     1.5      46
   23  $L    46     170     335     430     470     550     620
   24  $V  1950  1950.5  1951.2    1952  1952.6    1955    1960
   25  Y      0       0       0       1       1
   26  Y1     1       0       0       0       0       0     395
   27  $S     0       1     395    2140
   28  $E  1914    1920  1938.5    1960
   29  $$1938.5     115     3.7     1.5
   30  $D  1950     3.1     1.5      46
   31  $L    46     170     335     430     470     550     620
   32  $V  1950  1950.5  1951.2    1952  1952.6    1955    1960
   33  $B    70    0.25    1920     0.5  1938.5 1950.75
   34  K      1   STA 1                                       1
   35  K1       MOD PULS ROUTING OF FLOW FROM DAM TO STA 1
   36  Y      0       0       0       1       1
   37  Y1     1
   38  Y6  0.05   0.035    0.05    1908    1940    2900    0.01
   39  Y7     0    1940     550  1921.5     600    1920     615    1908     700  1908.
   40  Y7   715    1920    1565    1930    2165    1940
   41  K      1   STA 2                                       1
   42  K1       MOD PULS ROUTING OF FLOW FROM STA 1 TO STA 2
   43  Y      0                       1       1
   44  Y1     1
   45  Y6  0.05   0.035    0.05    1906    1940    2500   0.001
   46  Y7     0    1940     200    1920     220    1918     235    1906     320  1906.
   47  Y7   335    1918     350    1920    1450    1940
```

COMPUTER INPUT - BREACH CONDITION

```
48  K      1   STA 3                                                    1
49  K1       MOD PULS ROUTING OF FLOW FROM STA 2 TO STA 3
50  Y      0                          1       1
51  Y1     1
52  Y6  0.05   0.035    0.05    1905    1940    1200   0.001
53  Y7     0    1940     100    1930     140    1920     150    1905     250  1905.
54  Y7   265    1915     295    1920    1195    1940
55  K      1   STA 4                                                    1
56  K1       MOD PULS ROUTING OF FLOW FROM STA 3 TO STA 4
57  Y      0                          1       1
58  Y1     1
59  Y6  0.05   0.035    0.05    1902    1940    2900   0.001
60  Y7     0    1940       70    1920     110    1914     125    1902     195  1902.
61  Y7   215    1920     365    1938     385    1940
62  K     99
```

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1938.50	1938.50	1950.00
STORAGE	395.	395.	1328.
OUTFLOW	0.	0.	16594.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.37	1950.77	.77	1391.	18531.	3.00	44.00	0.00
.50	1952.44	2.44	1526.	25164.	6.00	43.50	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1938.50	1938.50	1950.00
STORAGE	395.	395.	1328.
OUTFLOW	0.	0.	16594.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.37	1950.77	.77	1391.	38184.	1.70	44.50	44.00
.50	1951.14	1.14	1421.	42458.	.78	42.50	42.00

PLAN 1 STATION STA 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	18539.	1918.5	44.00
.50	25144.	1920.4	43.50

PLAN 2 STATION STA 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	35304.	1922.6	44.50
.50	39024.	1923.2	42.50

PLAN 1 STATION STA 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	18528.	1924.7	44.00
.50	25183.	1927.0	44.00

PLAN 2 STATION STA 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	31403.	1928.7	45.00
.50	36964.	1930.0	43.00

PLAN 1 STATION STA 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	18499.	1923.2	44.00
.50	25190.	1925.8	44.00

COMPUTER OUTPUT - SUMARY BREACH CONDITION

PLAN 2 STATION STA 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	32323.	1928.1	45.00
.50	37658.	1929.5	43.00

PLAN 1 STATION STA 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	18459.	1923.4	44.00
.50	25186.	1926.7	44.00

PLAN 2 STATION STA 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	32360.	1929.7	45.00
.50	37320.	1931.5	43.00

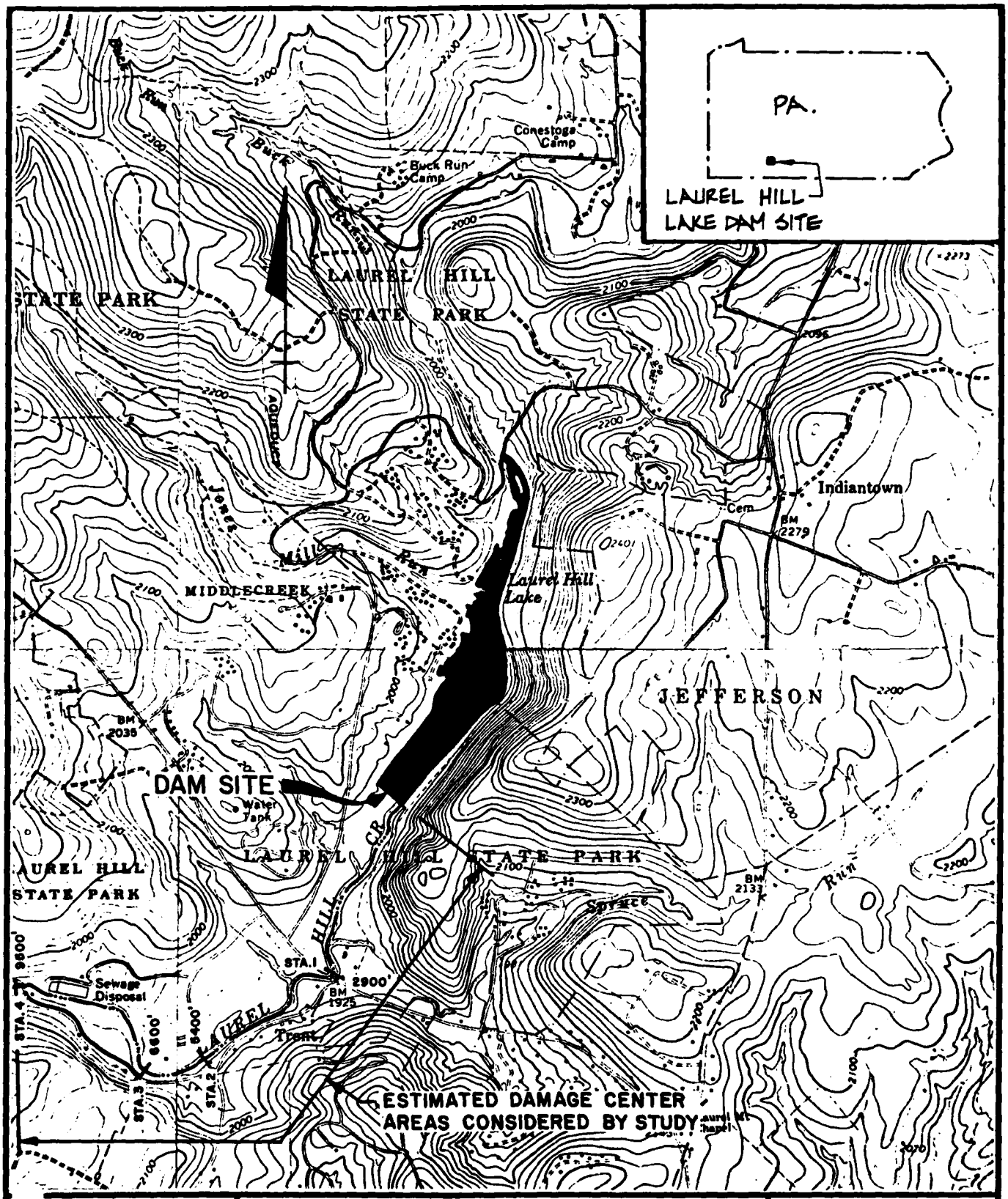
The following table summarizes flood stages calculated by the computer model for 37 percent PMF runoff before and after dam failure:

Damage Center	Maximum Flood Stage Before Failure	Maximum Flood Stage After Failure	Stage Increase (ft.)
Sta. 1	1918.5	1922.6	4.1
Sta. 2	1924.7	1928.7	4.0
Sta. 3	1923.2	1928.1	4.9
Sta. 4	1923.4	1929.7	6.3

SUMMARY OF FLOOD STAGES FOR 37 PERCENT PMF

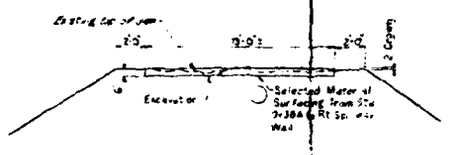
APPENDIX E

LOCATION PLAN AND PLATES

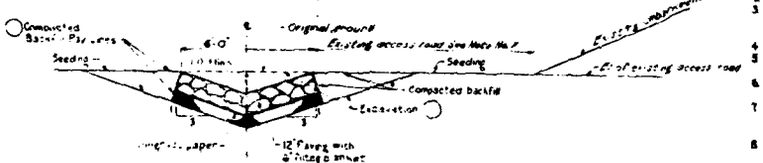


DATE: MARCH 21, 1980	NATIONAL DAM INSPECTION PROGRAM	LOCATION PLAN OF LAUREL HILL LAKE DAM SITE
SCALE: 1:24000		
DR: JLM CK: TED	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS BALTIMORE, MD.	
DWG. NO. E-1		

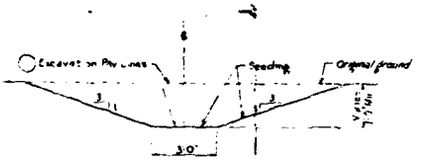
DWG. NO. R56:2-1.1



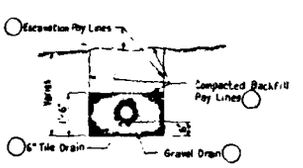
CREST DETAIL
Scale 4in=1ft.



GROUTED STONE GUTTER
Scale 1in=1ft.



TRAPEZOIDAL DITCH
Scale 1in=1ft.



Note Maintain slope of bottom of ditch at 0.005-0.01

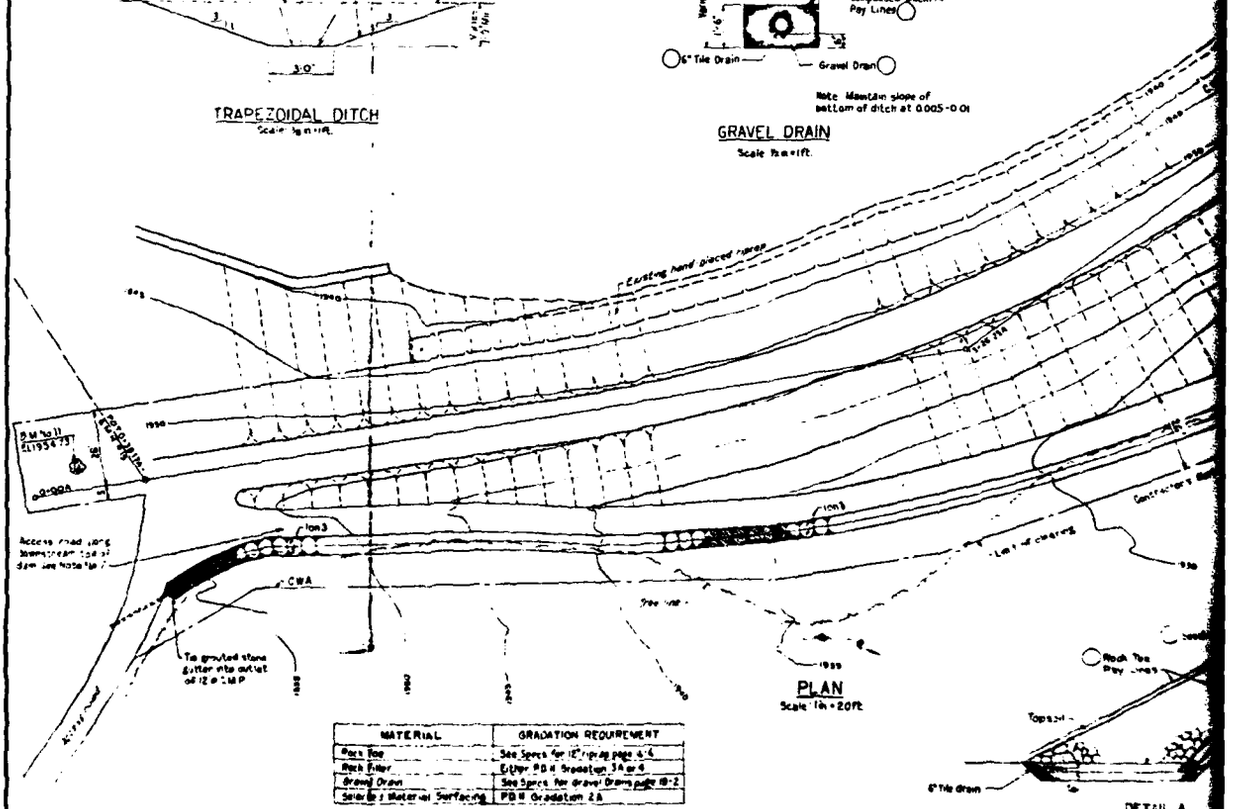
GRAVEL DRAIN
Scale 1in=1ft.

DRAWING INDEX

TITLE	DWG NO
GENERAL PLAN	1.1
RIGHT SPILLWAY WALL	1.2
LEFT SPILLWAY WALL	1.3
CONTROL STRUCTURE	1.4

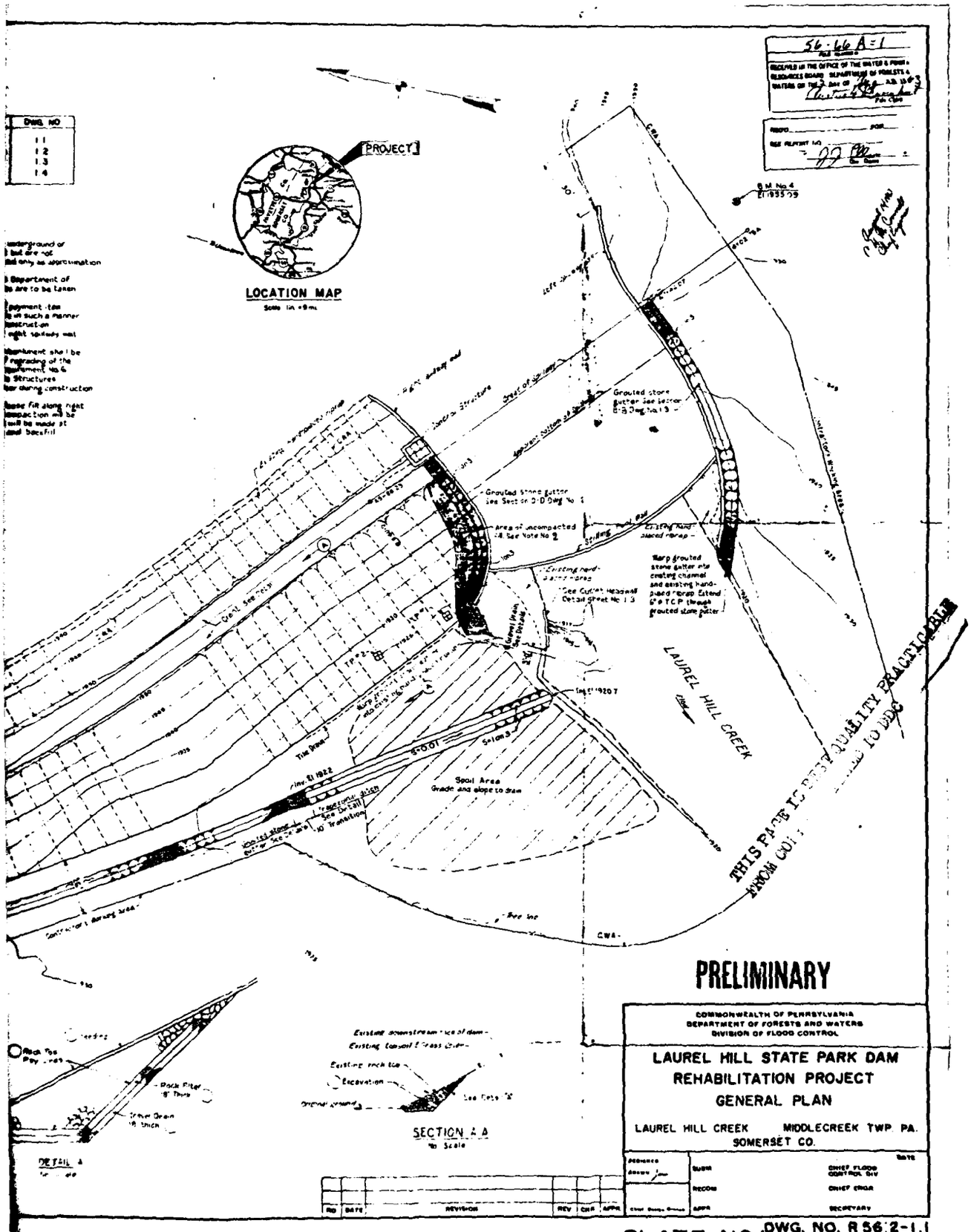
GENERAL NOTES:

1. Location and dimensions of structures that are underground or underwater are believed to be reasonably correct but are not guaranteed to be absolutely so and are presented only as approximations
2. For Concrete Notes, see Dwg. No. 1.2
3. All elevations shown are based on Pennsylvania Department of Forests and Waters datum Elevation of features are to be taken from bench marks shown on drawing
4. Numbers shown in circle as (3) indicate number of payment item
5. The Contractor shall, where directed, fill and grade in such a manner to provide drainage for areas adjacent to new construction
6. Chain link fence 4'-0" high to be erected on top of right spillway wall for full length See Dwg. No. 1.2
7. The minimum width of access road at toe of embankment shall be 10 feet To provide this width, a limited amount of regrading of the existing road may be necessary See Special Requirement No 6
8. The final depth and limit of Removal of Concrete Structures shall be determined be determined by the Engineer during construction of this project
9. It may be necessary to remove and recompact base fill along right spillway wall The limits of such removal and recompaction will be determined by the Engineer in the field Payment will be made at the applicable unit price for existing excavation and backfill

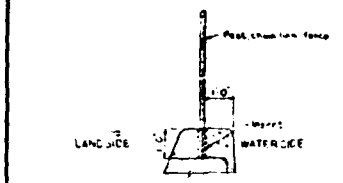


PLAN
Scale 1in=20ft.

MATERIAL	GRADATION REQUIREMENT
Rock Toe	See Specs for 12" riprap page 4-4
Rock Filler	Either PBR Gradation 3A or 4
Gravel Drain	See Specs for gravel Drains page 19-2
Selected Material Surfacing	PBR Gradation 2A


56-66 A-1
DWG. NO
1 1
1 2
1 3
1 4
PROJECT
LOCATION MAP
Scale 1in = 8 mi
B.M. No 4
Elev 1955.09
Grouted stone gutter see section D-D Dwg No 13
Grouted stone gutter see Section D-D Dwg No 13
Area of uncompacted fill. See Note No 2
Warp grouted stone gutter into existing channel and existing hand-placed riprap Extend 6" ø TCP through grouted stone gutter
See Outlet Headwall Detail Sheet No 13
LAUREL HILL CREEK
Spoil Area
Grade and slope to drain
Invt El 1922
Tie Rod
Rock Filter 8' Thick
Gravel Drain 18 Inch
DETAIL A
Existing downstream face of dam
Existing concrete
Existing rock toe
Excavation
SECTION A-A
PRELIMINARY
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS
DIVISION OF FLOOD CONTROL
LAUREL HILL STATE PARK DAM
REHABILITATION PROJECT
GENERAL PLAN
LAUREL HILL CREEK MIDDLECREEK TWP PA.
SOMERSET CO.
REVISIONS
PLATE NO. 1
DWG. NO. R 56:2-1.1

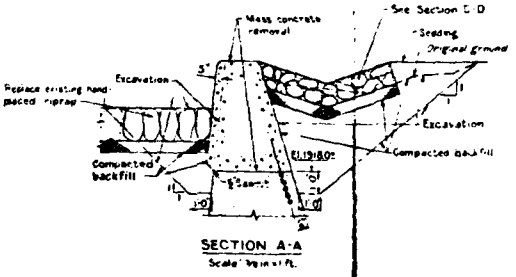
DWG. NO. R56.2-1.2



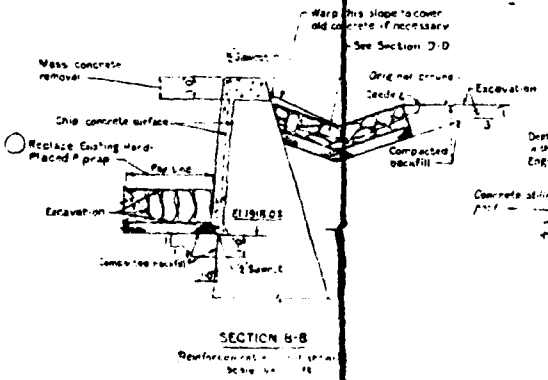
TYPICAL POST LOCATION

ELEVATION

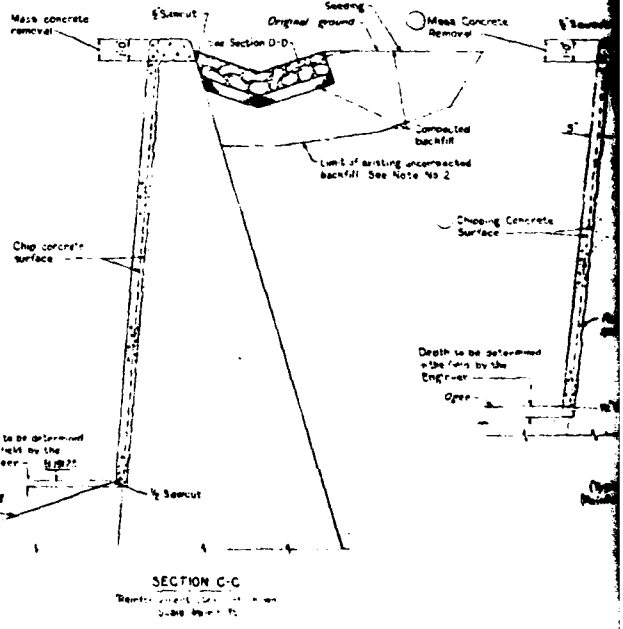
(True projection of curved spillway wall)



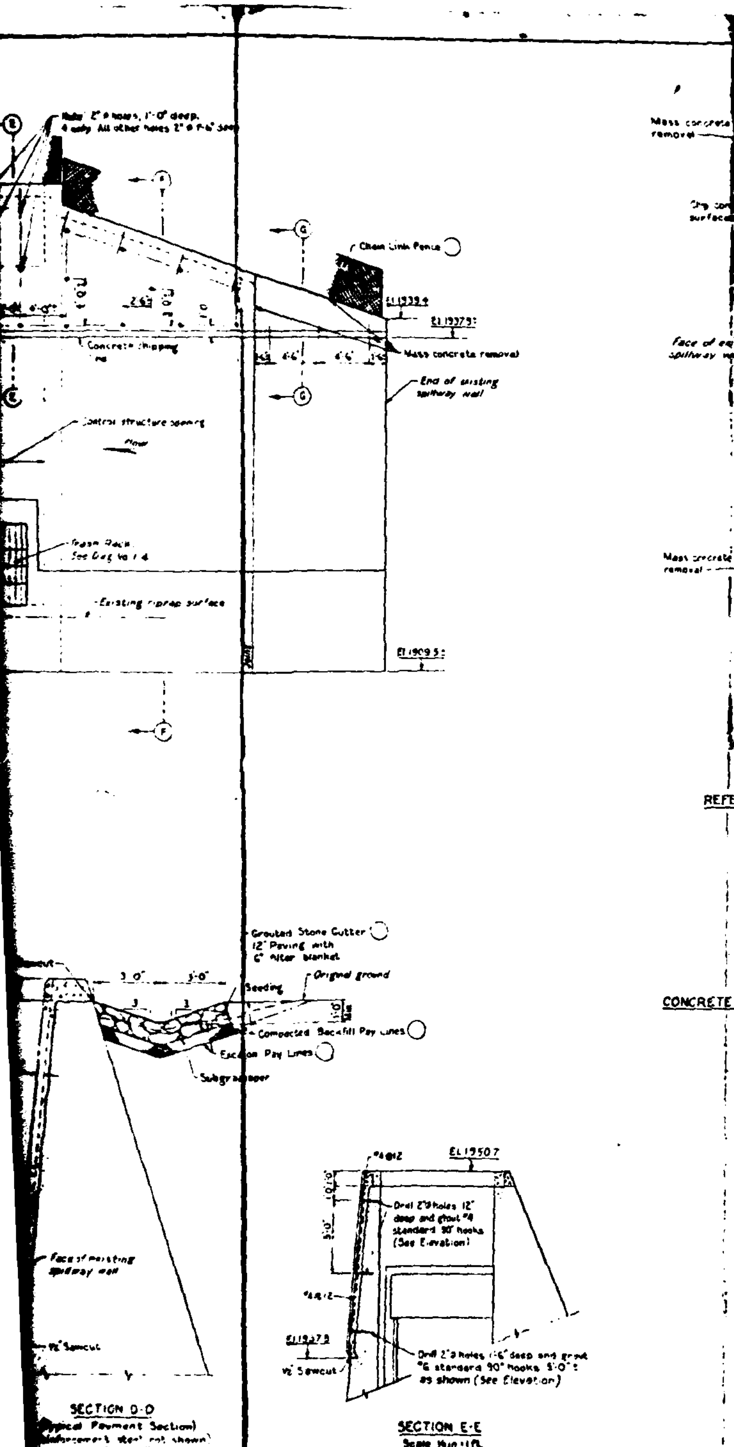
SECTION A-A

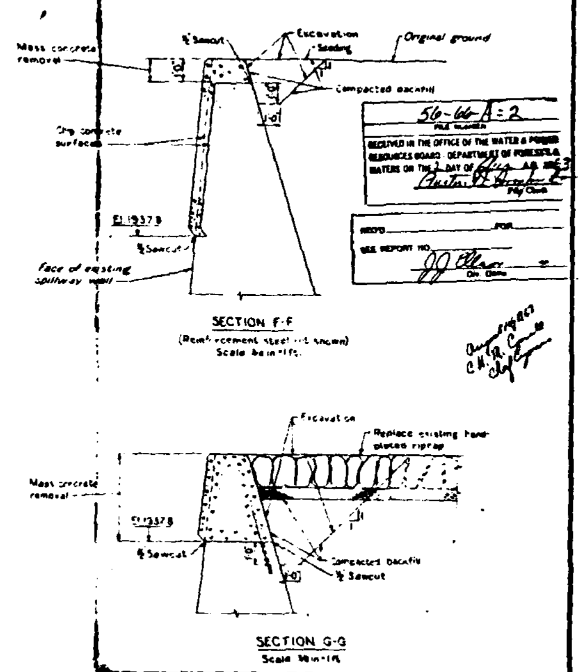


SECTION B-B



SECTION C-C





56-66-A-2

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD - DEPARTMENT OF FORESTS & WATERS ON THE 2 DAY OF

REFERENCES:

1. General Plan .... Dwg. No. 1.1
2. Left Spillway Wall .... Dwg. No. 1.3
3. Control Structure .... Dwg. No. 1.4

NOTES:

1. For General Notes, see Dwg. No. 1.1.
2. See Note No. 9, Dwg. No. 1.1.

CONCRETE NOTES:

1. Splices in the reinforcement are not shown on these Dwgs. Location of splices will be determined by the contractor in accordance with the provisions of paragraph 16.15 of the Standard Specifications subject to approval by the Engineer.
2. Chamfer all exposed edges and all exposed joints in walls ¾".
3. All concrete to be Grouted Concrete Aggregate unless otherwise indicated.
4. Concrete finish on any surface to be F_2 unless otherwise indicated.
5. All reinforcement 2" clear (edge of steel to surface of concrete) unless otherwise noted.
6. Prior to drilling anchor holes, concrete removal must be completed for any individual monolith. Location of anchor holes will then be approved by the Engineer.
7. Chain link fence not shown on sections.

PRELIMINARY

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS
DIVISION OF FLOOD CONTROL

LAUREL HILL STATE PARK DAM
REHABILITATION PROJECT
RIGHT SPILLWAY WALL

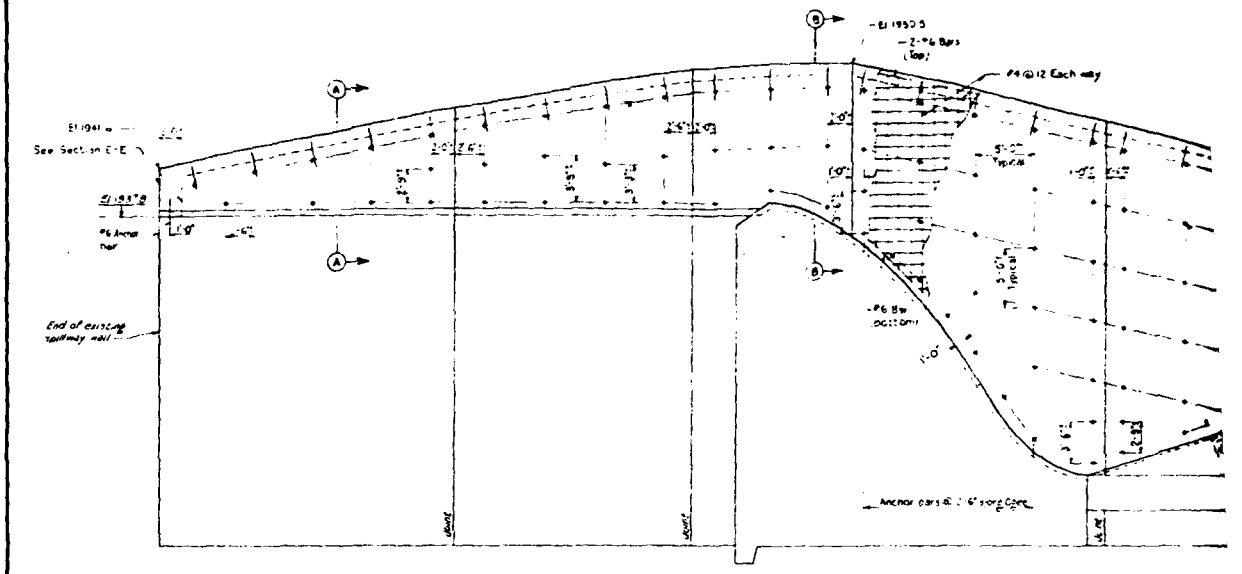
LAUREL HILL CREEK — MIDDLECREEK TWP. PA.
SOMERSET CO.

NO.	DATE	REVISION	REV	CHK.	APPR.

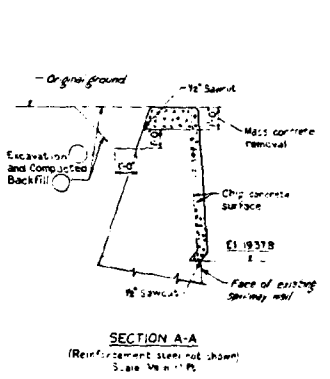
DWG. NO. R 56.2-1.2

PLATE NO. 2

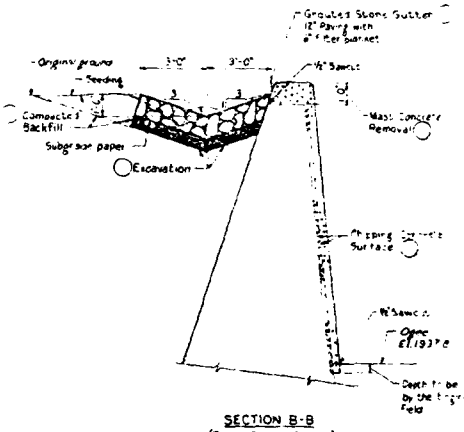
DWG. NO. R56:2-1.3



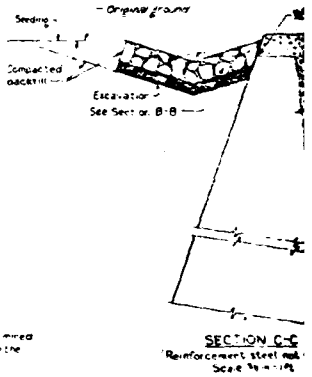
ELEVATI
Scale 1in=5ft



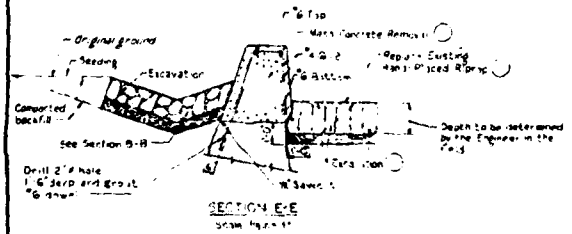
SECTION A-A
(Reinforcement steel not shown)
Scale 1in=1ft



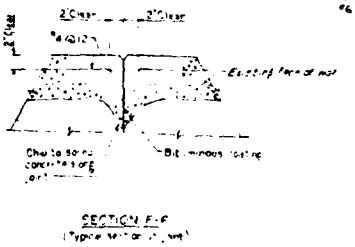
SECTION B-B
(Typical Pavement Section)
(Reinforcement steel not shown)
Scale 1in=1ft



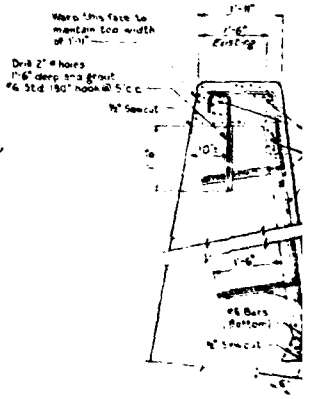
SECTION C-C
(Reinforcement steel not
Scale 1in=1ft



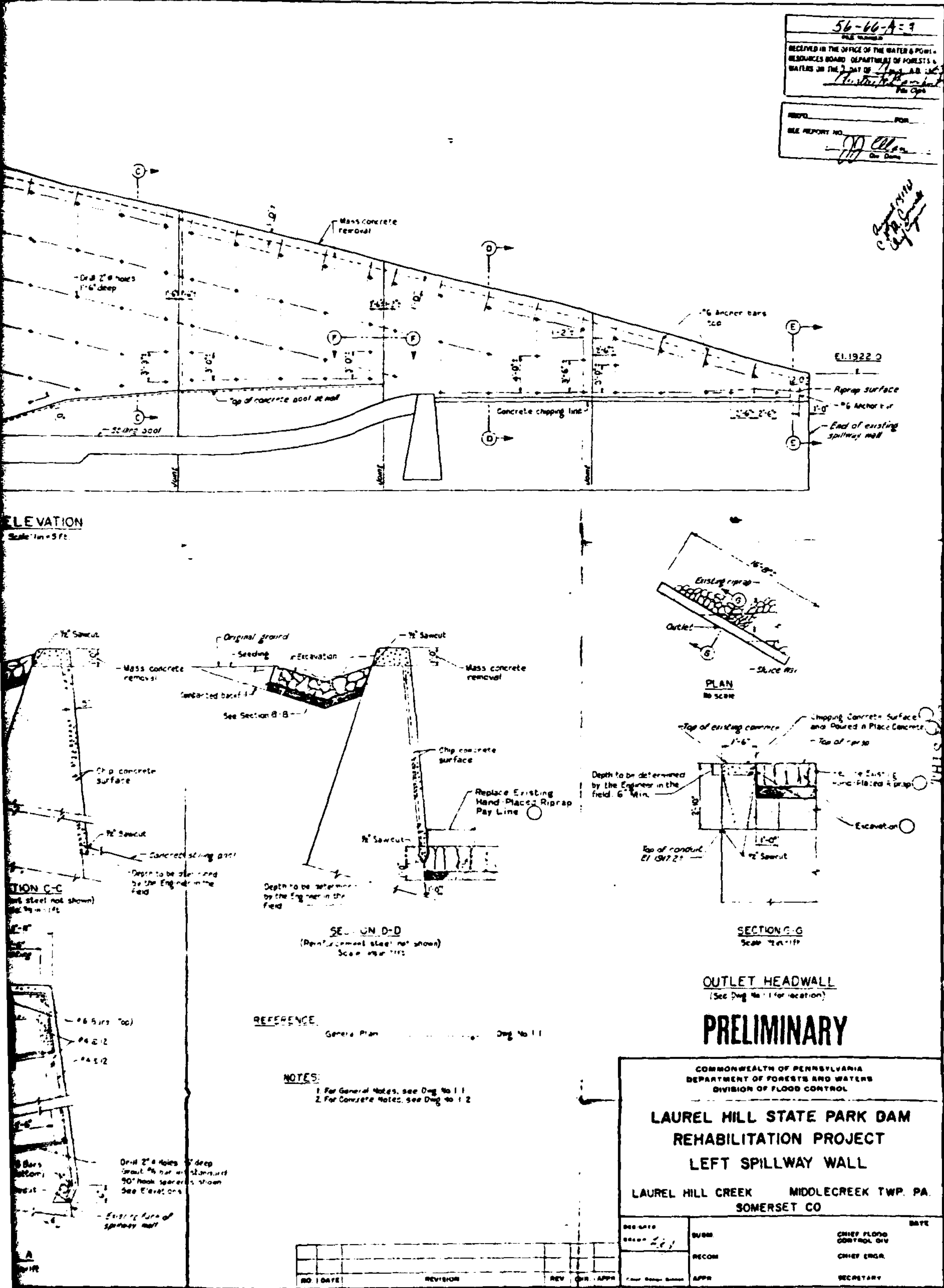
SECTION E-E
Scale 1in=1ft



SECTION F-F
(Typical Section at Culvert)
Scale 1in=1ft



DETAIL A
Scale 1in=1ft



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS
DIVISION OF FLOOD CONTROL

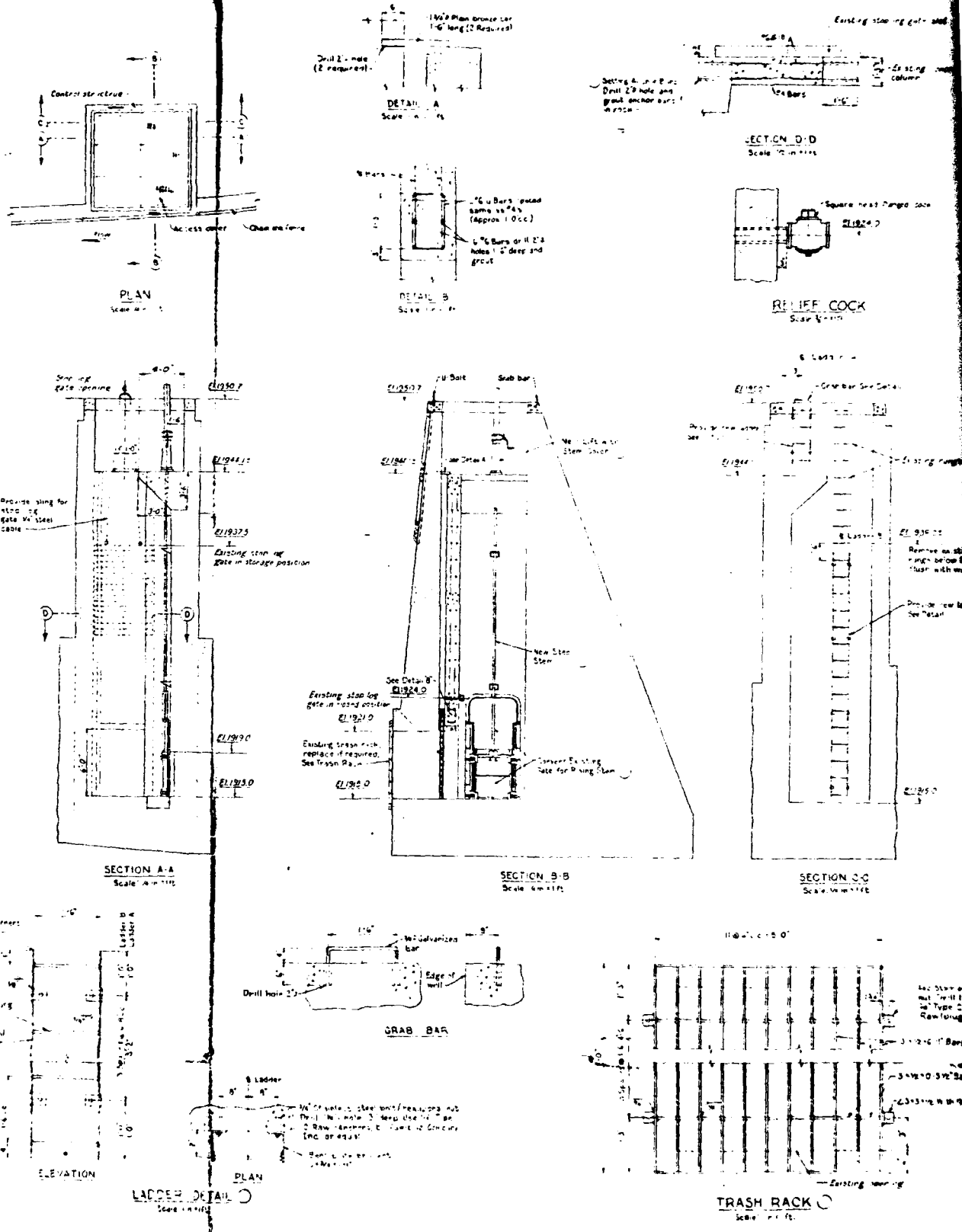
LAUREL HILL STATE PARK DAM
REHABILITATION PROJECT
LEFT SPILLWAY WALL

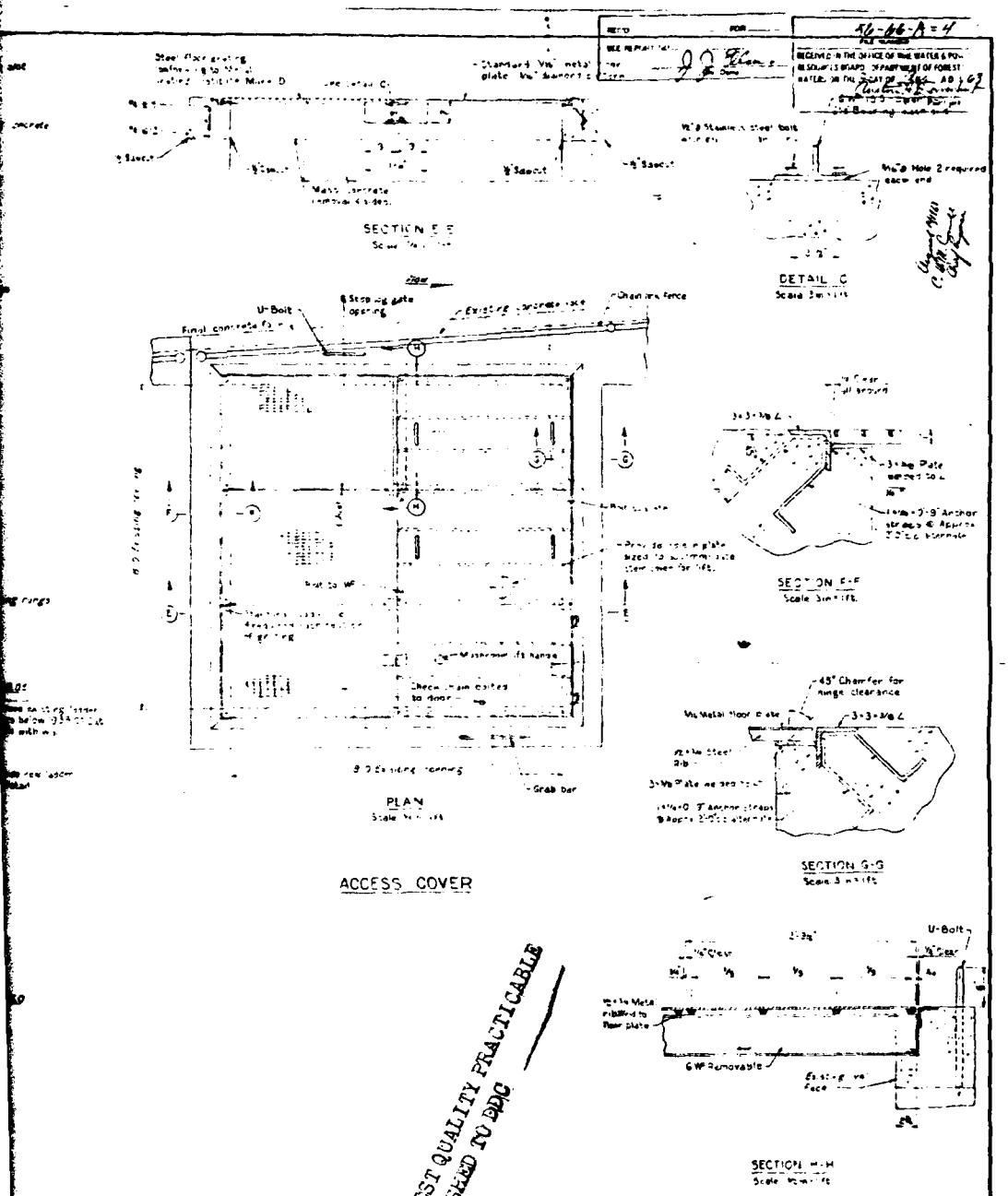
LAUREL HILL CREEK MIDDLECREEK TWP. PA.
SOMERSET CO

DWG. NO. R 56.2-1.3

PLATE NO. 3

DWG. NO. R56.2-14





PRELIMINARY

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS
DIVISION OF FLOOD CONTROL

LAUREL HILL STATE PARK DAM REHABILITATION PROJECT
CONTROL STRUCTURE

LAUREL HILL CREEK MIDDLECREEK TWP. PA.
SOMERSET CO

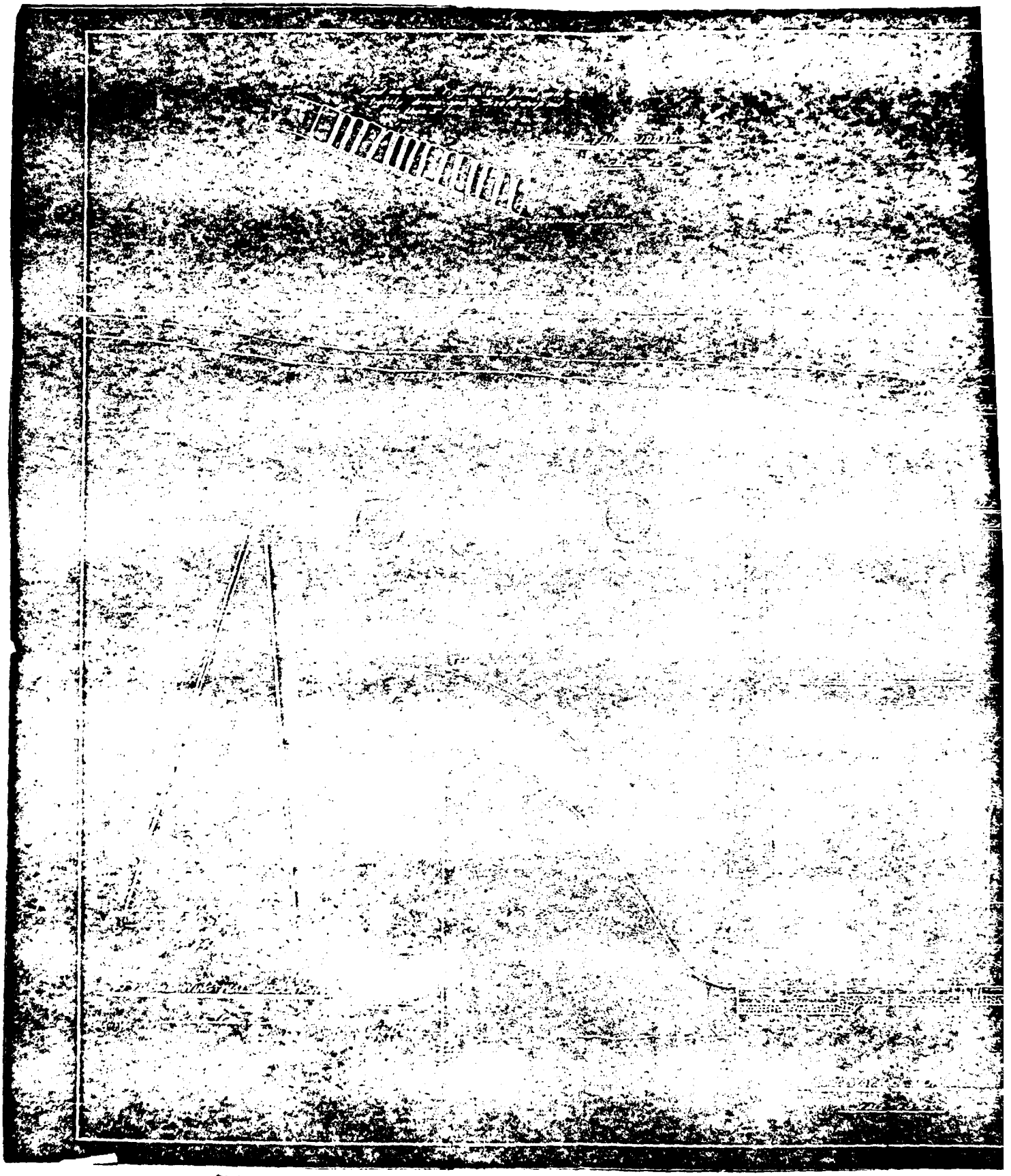
NO	DATE	REVISION	REV	CHK	APPD

DESIGNED DRAWN CHECKED RECOM APPD

CHIEF FLOOD CONTROL DIV
CHIEF ENGR
SECRETARY
DATE

DWG. NO. R 56.2-1.4

PLATE NO. 4



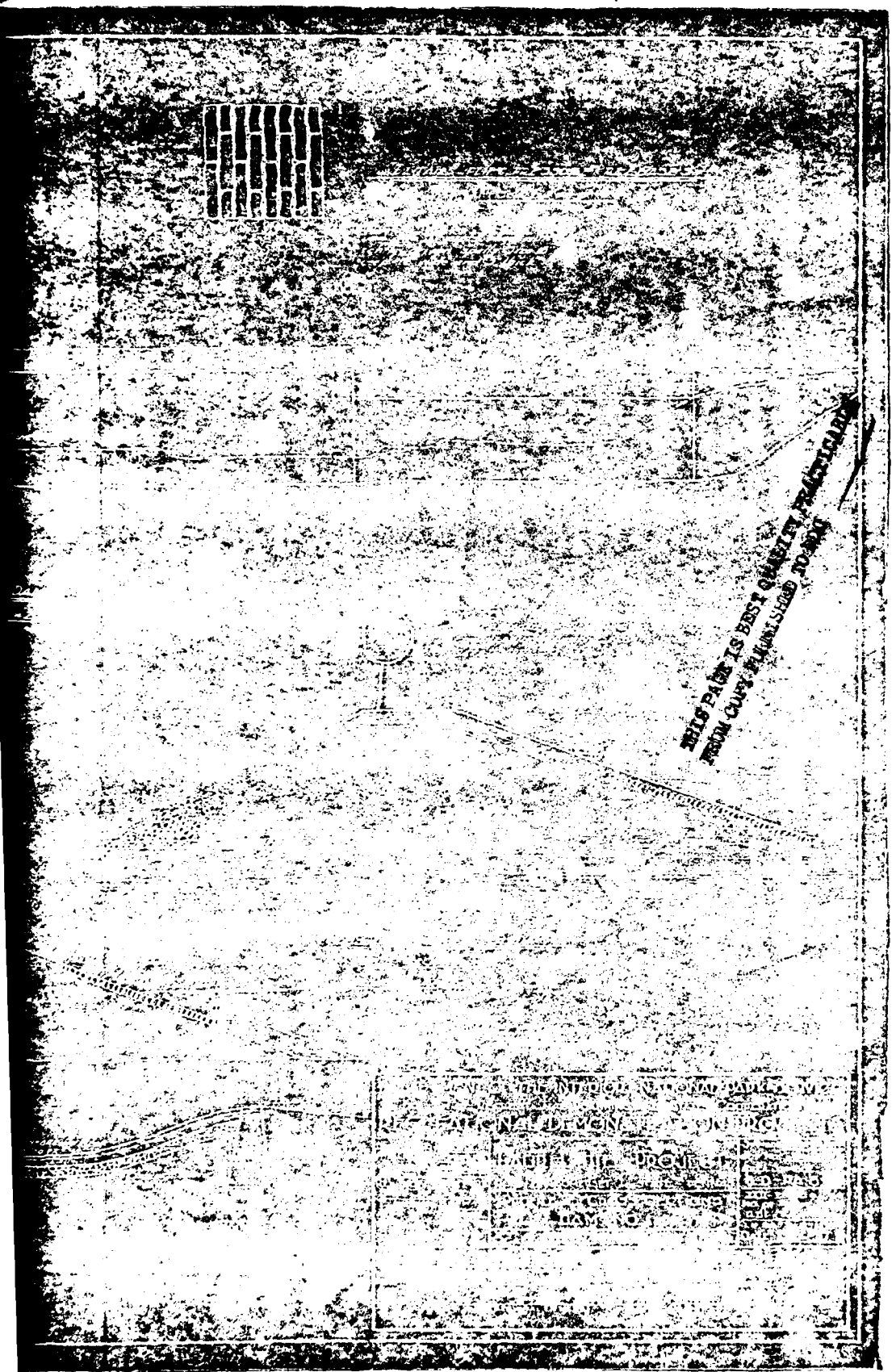


PLATE NO. 5

APPENDIX F

REGIONAL GEOLOGY

LAUREL HILL LAKE DAM
NDI ID. NO. PA 267
REGIONAL GEOLOGY

Laurel Hill Lake Dam is located approximately 3.5 miles north of New Lexington, Pennsylvania in the Allegheny Mountain section of the Appalachian Plateau Province. This section of the plateau contains flexures of moderate intensity having a dominant trend between north 30° east and north 35° east.

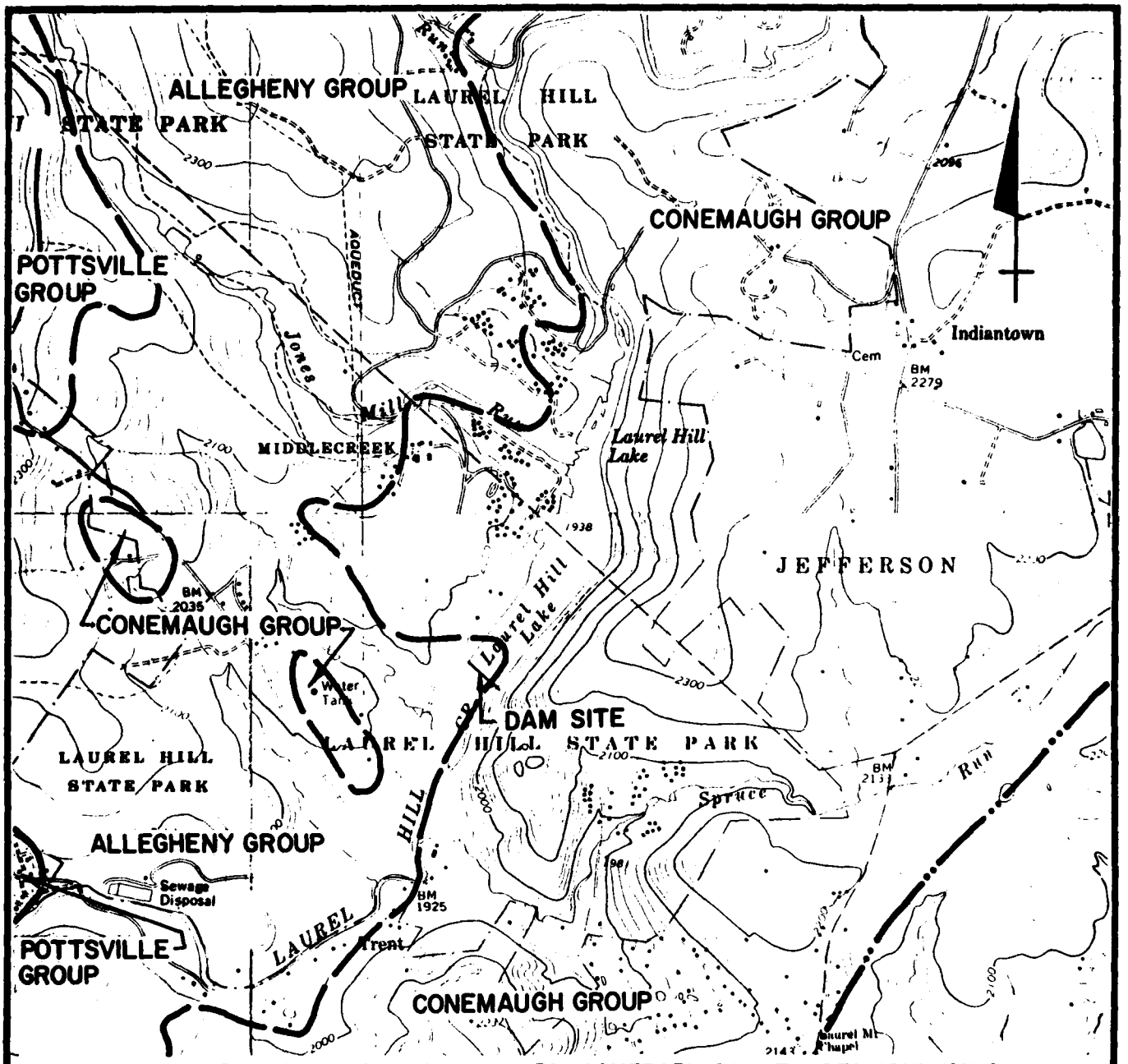
There is no evidence of faulting on the land surface in this area. However, considerable faulting occurs at depths over 3,000 ft. Based on the depth of the faults, these faults are not considered to present a significant hazard to the dam.

Laurel Hill Lake Dam is located approximately 0.35 miles west of the New Lexington Syncline axis. The strata underlying the dam constitutes the western flank of this syncline and dips gently to the southeast. The dam overlies the contact of the Glenshaw and Freeport Formations of the Conemaugh and Allegheny Groups, respectively. The Freeport Formation consists of alternating shale, sandstone, coal, and clay. The Freeport Formation also contains the mineable Upper and Lower Freeport coal seams. However, no mining activities have been recorded in the immediate area of the dam site.

The National Park Service design drawing (Plate No. 5) indicates the dam is underlain by sandy clay, shale, and sandstone.

References

Geology and Mineral Resources of Southern Somerset County, Pennsylvania, Norman L. Flint, Pennsylvania Geological Survey, 1965, County Report 56A.



ROCKWOOD & BAKERSVILLE QUADRANGLES, SOMERSET COUNTY PENNSYLVANIA

SCALE: 0 ——— ½ MILE 1:24000

CONTOUR INTERVAL 20FT. DATUM IS MEAN SEA LEVEL

——— ——— ——— INFERRED GROUP CONTACTS

———··———··——— NEW LEXINGTON SYNCLINE

DATA OBTAINED FROM PENNSYLVANIA GEOLOGICAL SURVEY'S GEOLOGIC MAP OF SOMERSET COUNTY, 1968 REVISED 1973

DATE: MARCH 21, 1980		NATIONAL DAM INSPECTION PROGRAM	SITE GEOLOGY OF LAUREL HILL LAKE DAM
SCALE: AS SHOWN			
DR: JLM	CK: GRG	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS BALTIMORE, MD.	
DWG. NO.	F-2		